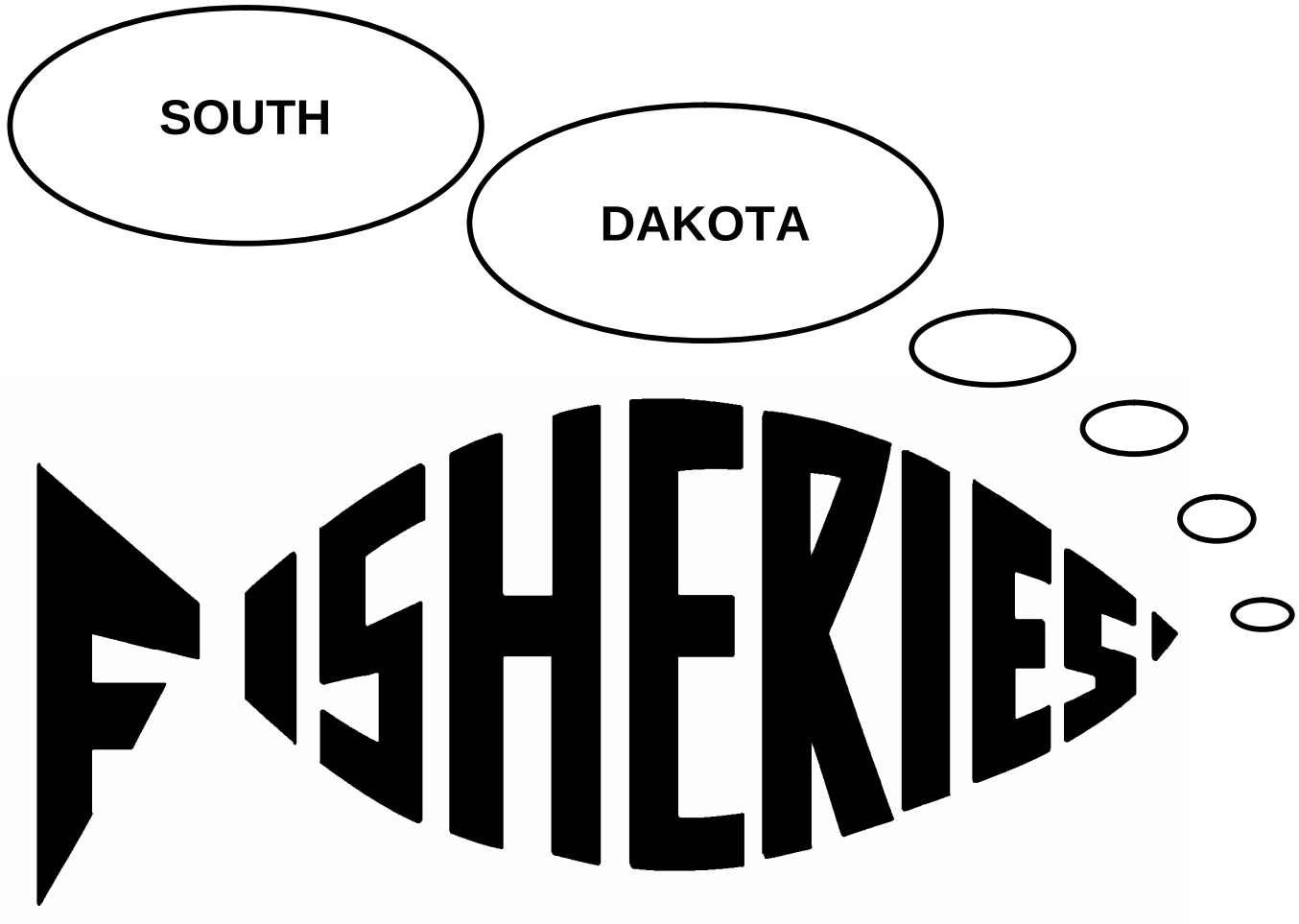

ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCES SURVEYS ON LAKE OAHE, SOUTH DAKOTA, 2003

South Dakota Department of Game, Fish and Parks
Wildlife Division
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Progress Report
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ANNUAL FISH POPULATION
AND
ANGLER USE, HARVEST AND PREFERENCE SURVEYS
ON
LAKE OAHE, SOUTH DAKOTA, 2003

by

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PREFACE

Information collected during 2003 is summarized in this report. Copies of this report and references to the data can be made with permission from the authors or Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, South Dakota 57501-3182.

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EXECUTIVE SUMMARY

This report includes annual fish population survey data from 1999 through 2003 and angler use, harvest, and preference data from 2003. Angler use and harvest data from previous years is also referenced in this report. Results of these surveys are a major evaluation strategy for planning efforts outlined in the Missouri River Fisheries Program Strategic Plan. Results and discussion pertain to changes in fish community, fish population and angler use, harvest, and preference characteristics. Evaluations of regulations and other management activities are also included in this report.

Channel catfish was the most abundant species in the coolwater gill net survey catch, followed by walleye, white bass, and yellow perch, in order of decreasing mean catch per unit effort (CPUE). Mean gizzard shad CPUE in 2003, at 1.6 fish/net-night, was the highest documented since standard gill net surveys were initiated in 1981.

Gizzard shad was the most abundant species in seine catches in 2003; the first time since the standard seining survey was initiated in 1981. Gizzard shad was followed by white bass, emerald shiner, and spottail shiner, in order of decreasing abundance in seine catches.

Mean walleye CPUE in the standard coolwater gill net survey decreased from 18.3 walleye/net-night in 2002 to 13.8 walleye/net-night in 2003. The mean walleye CPUE for 2003, for upper Lake Oahe, at 14.9 fish/net-night, was significantly lower than other years in the 1997-2003 period. Mean CPUE of walleye in the standard gill net survey was similar for middle and upper Lake Oahe in 2003, at 16.6 and 14.9 fish/net-night, respectively. Mean walleye CPUE for lower Lake Oahe in the 2003, at 9.7 fish/net-night, was significantly lower in lower Lake Oahe than other zones.

Walleye age distribution data from otolith analyses illustrates the dominance of the 1999- and 2001-year classes in the 2003 Lake Oahe walleye population. Based on a mean age-0 walleye CPUE of 0.2 fish/net-night in the 2003 standard gill net survey, 2003 appeared to be a low year for walleye production in Lake Oahe.

Walleye condition in lower Lake Oahe increased from 2002 to 2003, while values for middle and upper Lake Oahe were unchanged from 2002. Walleye growth rates slowed considerably from the 1991-1995 period to the 1997-2002 period. However, there are indications walleye growth rates are increasing. Mean length of walleye in the 1994 year class increased from 450 mm in 2002 (age 8) to 496 mm in 2003 (age 9) and mean length of fish in the 1995 year class increased from 435 mm in 2002 (age 7) to 454 mm in 2003 (age 8). Estimated annual mortality generated for 2002-2003 pooled age frequency data (otolith sample) from gill net samples was 45%.

Estimated fishing pressure for the April-October 2003 daylight period, at 651,557 h, was the second lowest of years for which an April-October survey was conducted and was 76% of the 2002 estimate of 856,059 h. Estimated walleye harvest for the 2003 survey period, at 181,528 fish, was the lowest of years for which April-October surveys were conducted. The mean walleye catch rate for the April-October daylight period decreased from 0.59 fish/angler-h in 2002 to 0.42 fish/angler-h in 2003.

While approximately 69% of the total estimated fishing pressure occurred during June and July in 2003, 81% of the estimated walleye catch and 77% of the estimated harvest occurred during these two months. As with fishing pressure, walleye harvest was highest in middle Lake Oahe during the April-October 2003 period, at an estimated 91,960 fish.

Approximately 26% of angler trips on Lake Oahe during the April-October 2003 daylight period were made by nonresidents, a value similar to previous years. For the April-October 2003 daylight period, Lake Oahe anglers contributed approximately 7.4 million dollars to local economies, based on an estimated 121,107 trips at an estimated $61 per trip for South Dakota’s Missouri River reservoirs.

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ANNUAL FISH POPULATION AND ANGLER USE, HARVEST AND PREFERENCE SURVEYS ON LAKE OAHE, SOUTH DAKOTA 2003

INTRODUCTION

Lake Oahe is an extremely valuable fisheries resource for the state of South Dakota, annually supporting between 159,000 and 338,000 angler trips during the 1990s (Lott et al. 2000). The Lake Oahe fishery had an estimated economic value of over $23.25 million for the April-October 1998 daylight period, based on information provided by the United States Census Bureau (2003). In 2002 approximately 174,700 angler trips occurred on Lake Oahe for an estimated economic value of $10.6 million (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2003). Because of the importance of Lake Oahe fisheries resources, they must be effectively managed to produce optimal recreational benefits. A prerequisite to the development of effective management strategies is the annual acquisition and analysis of data describing fish community and population parameters, angler use and harvest of these populations, and angler preference and satisfaction data. These surveys provide essential information used in the evaluation of accomplishments towards objectives of the South Dakota Department of Game, Fish and Parks (SDGF&P) Missouri River Program Strategic Plan (SDGF&P 1994) and more specifically, the Lake Oahe Strategic Plan (LOSP). This report also evaluates fisheries management activities (regulations and stocking) and effects of environmental variables (water levels, weather, etc.) on Lake Oahe fisheries.

OBJECTIVES

The objectives of the annual fish population and associated surveys (Federal Aid Code 2102) are to provide information on:

(1) species composition and relative abundance
(2) population size structure
(3) individual fish condition
(4) age, growth and recruitment
(5) survival and mortality rates
(6) fish reproduction
(7) zooplankton community status
(8) effects of regulations
(9) success of stocking and other management activities
(10) effects of sport fish harvest on fish population status

Emphasis is given to selected species that may be important from a sport or prey perspective. Common and scientific names of fishes collected or observed during these surveys are listed in Appendix 1.

The objectives of the angler use, harvest, and preference surveys (Federal Aid Code 2109) are to:

(1) Estimate recreational angling pressure.
(2) Estimate fish harvest, by species.
(3) Estimate fish harvest rates and catch rates, by species.
(4) Provide statistics on mean angler party size, mean length of angler day, and angler residency.
(5) Provide estimates of the annual economic impact of Lake Oahe's fishery.
(6) Document the effects of walleye harvest regulations on the sport fishery and the walleye population.
(7) Document angler attitudes, preferences, and level of satisfaction.

STUDY AREA

Lake Oahe is a mainstem Missouri River storage reservoir located in north-central South Dakota, downstream from Lake Sakakawea and upstream of Lake Sharpe. Historical, biological, chemical, and physical parameters have been discussed in North Central Reservoir Investigation reports (June 1974; Selgeby and Jones 1974) and South Dakota Game, Fish and Parks reports (Warnick 1987). Table 1 presents selected physical characteristics and a fisheries-management classification for Lake Oahe in South Dakota (Michaletz et al. 1986).

Table 1. Physical characteristics and management classification of Lake Oahe, South Dakota.

Oahe Dam Closed in:	1958	***Reservoir length:**	372 km
Elevation at full pool:	1617 msl	***Shoreline length:**	3,620 km
***Surface area: (SD portion)**	110,660 ha	**Shoreline Devel. index:**	26.4
***Water volume:**	2.9×10^{13} L	**Drainage area:**	630,639 km^2
***+Coldwater habitat:**	47,755 ha	***Average depth:**	18.3 m
Trophic Status:	Oligo/meso	***Maximum depth:**	62.5 m
Bottom composition:	sand, gravel, clay and shale	**Morpho-edaphic index:**	28.4
Management Classification:	cold, cool and warmwater permanent	**Water source:**	Missouri River and tributaries

*Denotes values for water elevation at full pool.

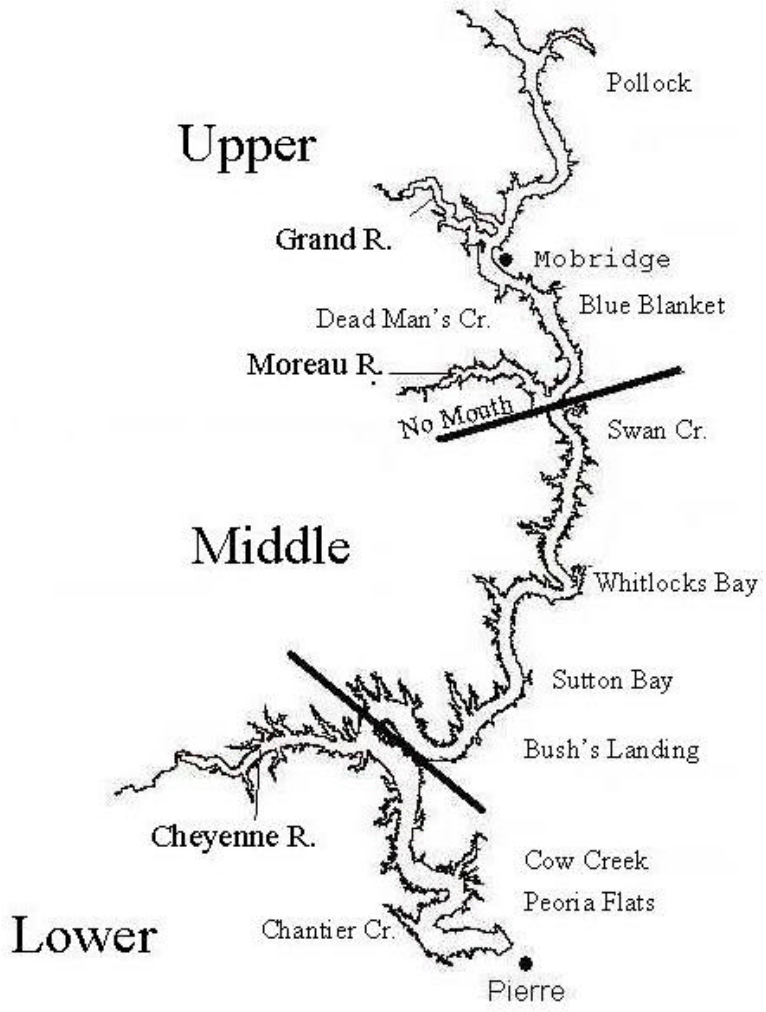
+Denotes upper surface area of water $\leq 15^{o}C$ in August.

SAMPLING METHODS AND SCHEDULE

FISH POPULATION AND ASSOCIATED SURVEYS

DATA COLLECTION

Gill nets, seines, and larval trawls were used to sample fish. Times and depths of fish population surveys are presented in Table 2.



Location	Gill net	Seine	Larval trawl
Pollock	•	•	•
Grand River	•	•	•
Deadman's Creek			•
Blue Blanket	•	•	
Swan Creek		•	
No Mouth Creek			•
Moreau River	•	•	
Whitlocks Bay	•	•	•
Sutton Bay			•
Bush's Landing	•		
Cheyenne River	•	•	•
Cow Creek	•	•	•
Chantier Creek.			•
Peoria Flats	•	•	

Figure 1. Fish population sampling stations on Lake Oahe, South Dakota, for 2003.

The standard coolwater fish population survey consists of setting three standard gill nets, overnight (approximately 20 h), on the bottom, in each depth zone (where possible), at each station (Table 2, Figure 1). A standard gill net of multifilament nylon was 91.4-m (300-ft) long x 1.8-m (6-ft) deep with 15.2-m (50-ft) panels of the following bar mesh sizes: 12.7 mm (1/2 in), 19.1 mm (3/4 in), 25.4 mm (1 in), 31.8 mm (1 1/4 in), 38.1 mm (1 1/2 in), and 50.8 mm (2 in).

Table 2. Sampling times, depths, and gears for annual fish population and zooplankton surveys on Lake Oahe, South Dakota.

Survey	Time	Survey Gear	Sampling Specifics
Coolwater gill net	August	Standard gill nets	Three shallow (0-9 m) and three deep (9-18 m), at standardized locations, at each station
Seining	August	30.5-m by 2.4-m bag seine, 6.4-mm mesh	Four, quarter arc, pulls at each station
Larval trawling	May-June	1x2-m limnetic trawls, 0.5-mm mesh	Two paired trawl hauls/week for three consecutive weeks of 5 minutes duration at each station

All walleye collected during the coolwater gill net survey were measured for total length (TL; mm) and weighed (g). Scale and otolith samples were collected from 10 walleye per 10-mm length group, at each sampling station (Figure 1). Scales were removed from a location below the lateral line and posterior of the pectoral fin (Al-Absy and Carlander 1988). A representative sample of at least 50 individuals per sampling station was measured and weighed for all other species, where possible.

A nylon, 6.4-mm (1/4-in) mesh bag seine, measuring 30.5-m (100-ft) long x 2.4-m (8-ft) deep, with a 1.8-m (6-ft) x 1.8-m (6-ft) bag, was used to collect age-0 fishes and small littoral species. A quarter-arc seine haul was accomplished using methods described in Martin et al. (1981). Four seine hauls were made at each sampling station (Figure 1). All fish collected with seine hauls were identified, counted, and classified as age-0 or other.

Larval fish densities were estimated for Lake Oahe by sampling with paired limnetic larval trawls. Each trawl had a mesh size of 0.5 mm (bar measure), a 1-m x 2-m opening and was equipped with a flow meter. Trawling was performed at night. Each trawl haul lasted approximately five minutes. Two paired trawl hauls were made at each sampling station (Figure 1). Eight stations, throughout Lake Oahe, were sampled weekly during late May and early June of 2003. All samples were preserved in 10% formalin and later identified and enumerated.

DATA ANALYSIS

Relative abundance of fish species was expressed as mean catch per unit effort (CPUE) for gill net (No./net night), and seine (No./haul) catches. Walleye CPUE for coolwater gill net samples were tested for differences among areas within Lake Oahe (Figure 1) using a one-way analysis of variance (ANOVA) and the Least Squares Means procedure (SYSTAT 1998; Sokal and Rohlf 1981).

Age and growth analyses were conducted for walleye. Scales were aged according to standard techniques (DeVries and Frie 1996). Walleye otoliths were cracked through the focus and charred using a propane torch prior to age interpretation to make annuli easier to distinguish. Back-calculations were generated for walleye scales using annuli measurements from the focus, with the computer program WinFin (Francis 2000). A standard y-intercept value, suggested by Carlander (1982), of 55 mm was used for walleye scales. Age distributions for gill-net catches were developed by assigning ages to all walleye captured during the survey, based on length-at-age-at-time-of-capture information. Regression equations of walleye initial length vs. new length added were calculated, for scale data, in WinFin and used to generate incremental growth estimates for walleye.

Survival and mortality estimates for walleye were calculated using catch curves (Ricker 1975). When estimating mortality rates for walleye, two consecutive years of age-distribution data were combined to reduce the effects of variable recruitment. Catch curves were examined to determine the age at which fish of each species were fully recruited to the sampling gear. Instantaneous mortality rates (Z) were estimated using the slope of the regression of the natural logarithm of the number of fish at each age versus fish age.

Proportional stock density (PSD; Anderson and Weithman 1978) and relative stock density (RSD) values were calculated for channel catfish, smallmouth bass, white bass, walleye and yellow perch (Gabelhouse 1984). Stock Density Index values were tested for differences among years using Chi-square analysis (Conover 1980). Length categories used to calculate PSD and RSD values are listed in Table 3.

Table 3. Minimum lengths (mm) of length-class designations for calculating proportional stock density and relative stock density values for fish population surveys.

Species	Length class				
	Stock	Quality	Preferred	Memorable	Trophy
Channel catfish	280	410	610	710	910
Smallmouth bass	180	280	350	430	510
Walleye	250	380	510	630	760
White bass	150	230	300	380	460
Yellow perch	130	200	250	300	380

Relative weight values (*Wr;* Anderson 1980) were calculated using standard-weight (*Ws*) equations developed for walleye (Murphy et al. 1990), yellow perch (Willis et al. 1991), channel catfish (Brown et al. 1995), and white bass (Brown and Murphy 1991). Standard-weight equations used in this report are provided in Appendix 2 and calculated values for yellow perch and white bass are presented in Appendix 3. Relative weight values for walleye were tested for differences among length-class designations using one-way ANOVA (SYSTAT 1998). Mean *Wr* for stock-length fish was reported when no significant differences were detected among length classes ($P<0.05$). All statistical tests were performed using a significance level of 0.05, unless otherwise stated.

ANGLER USE AND HARVEST SURVEY

Angler use and sport fish harvest surveys conducted on Lake Oahe are patterned after a study designed by Schmidt (1975) for Lake Sharpe. Sampling includes aerial boat and shore angler counts to estimate fishing pressure, and angler interviews at lake access areas to estimate harvest rates, catch rates, release rates, mean party size, mean angler day length, target species, and angler state of residency. Flight dates and interview dates were selected using a stratified random design based on the assumption of different levels of fishing pressure for weekdays, and weekend days and holidays. Lake access areas for angler interviews were also assigned using a stratified random design, with probabilities of assignment differing by access area and month.

Sampling was conducted from April 1, 2003 through October 31, 2003, for the sunrise to sunset period. Creel zones are the same as fish population survey zones identified in Figure 1. Aerial pressure counts were made during all months. For a more detailed description of aerial count, angler interview, and data expansion techniques see Stone et al. (1994). Pressure count and angler interview data were entered and analyzed using the Creel Application Software (CAS) package (Soupir and Brown 2002) and 95% confidence intervals were calculated for estimates of fishing pressure and harvest.

ANGLER PREFERENCE AND ATTITUDE SURVEY

Angler preference questions were included in each angler interview during the 2003 angler use and harvest survey. Two different versions (forms A and B) of the Lake Oahe angler use and harvest data sheet were generated, with different sets of angler attitude or preference questions on each sheet. Clerks alternated between forms A and B during each scheduled interview day. Anglers were asked to rate their fishing trip based on the numbers and sizes of fish they were expecting to catch. Anglers were also asked to state how satisfied they were with their fishing trip considering all factors. Other questions asked included angler age and if they were in favor of current Lake Oahe walleye regulations. A list of attitude and preference questions used during the 2003 survey appears in Appendix 4. Median values for trip rating and satisfaction question responses were calculated for each month and for the entire sample. Chi-square tests were used to determine if differences existed in distances anglers traveled, one way, to fish Lake Oahe, and in percentage of total non-residents from the various states, among years (Conover 1980).

RESULTS AND DISCUSSION

FISH POPULATION AND ASSOCIATED SURVEYS

COOLWATER FISH POPULATION SURVEYS

Species Composition and Relative Abundance

Twenty-two fish species were collected during the coolwater gill net survey in 2003 (Table 4). Channel catfish was the most abundant species in the coolwater gill net survey catch, followed by walleye, white bass, and yellow perch, in order of decreasing mean CPUE. Mean CPUE for all species collected were within ranges previously observed, with the exception of gizzard shad (Michaletz et al. 1986; Riis et al. 1988; Stone et al. 1989; Johnson et al. 1990; Wickstrom et al. 1991; Johnson et al. 1992; Wickstrom et al. 1993; Lott et al. 1994; Johnson et al. 1995, 1996, 1997, 1998, 1999; Lott et al. 2000, 2001, 2002, 2003a). Mean gizzard shad CPUE in 2003, at 1.6 fish/net-night, was the highest documented since standard gill net surveys were initiated in 1981.

Table 4. Mean catch per unit effort (No./net-night) for fish species collected with standard coolwater gill net sets in Lake Oahe, South Dakota, 1999-2003. Trace (T) indicates values less than 0.05. Standard errors are in parenthesis.

Species	Year				
	1999	2000	2001	2002	2003
Bigmouth buffalo	0.1 (0.1)	0.0	T	0.1(T)	0.1 (0.1)
Black bullhead	0.0	0.0	0.0	0.0	T
Black crappie	T	0.0	0.0	0.0	T
Channel catfish	14.7 (0.4)	16.1 (1.4)	16.5 (1.5)	19.1 (2.3)	15.6 (1.4)
Chinook salmon	0.0	0.0	T	0.0	0.0
Common carp	1.0 (0.2)	1.4 (0.3)	1.0 (0.2)	1.1 (0.2)	1.1 (0.2)
Freshwater drum	0.6 (0.1)	0.9 (0.2)	1.3 (0.3)	1.0 (0.2)	1.6 (0.3)
Gizzard shad	0.1 (0.1)	0.1 (0.1)	1.0 (0.8)	0.2 (0.1)	1.6 (0.5)
Goldeye	3.1 (0.4)	2.1 (0.5)	1.3 (0.3)	1.1 (0.5)	2.1 (0.5)
Lake herring	0.0	T	0.0	0.1 (T)	0.0
Northern pike	0.3 (0.1)	0.4 (0.1)	0.1 (0.04)	0.2 (0.1)	0.2 (0.1)
Rainbow smelt	0.0	0.0	0.1 (0.1)	0.1 (0.1)	T
River carpsucker	0.4 (0.1)	0.6(0.2)	1.3 (0.4)	1.3 (0.3)	1.3 (0.2)
Sauger	0.1 (0.1)	T	0.1 (0.1)	0.2 (0.1)	0.1 (T)
Shorthead redhorse	4.1 (0.4)	1.6 (0.3)	0.5 (0.2)	1.7 (0.5)	0.7 (0.2)
Shortnose gar	0.0	T	0.0	0.1 (0.1)	T
Shovelnose sturgeon	T	0.0	T	T	0.0
Smallmouth bass	1.0 (0.2)	0.4 (0.1)	0.4 (0.2)	0.5 (0.1)	0.3 (0.1)
Smallmouth buffalo	0.3 (0.1)	0.1 (0.1)	0.2 (0.1)	0.2 (0.1)	0.1 (T)
Spottail shiner	0.1 (0.1)	T	0.1 (T)	0.2 (0.1)	0.1 (0.1)
Walleye	21.6 (0.5)	19.4 (2.1)	14.9 (2.0)	18.3 (2.4)	13.8 (1.5)
White bass	11.0 (0.6)	3.8 (0.6)	10.6 (2.3)	3.1 (0.7)	3.0 (0.8)
White crappie	1.7 (0.3)	1.1 (0.4)	0.6 (0.3)	0.2 (0.1)	0.1 (T)
White sucker	0.2 (0.1)	0.4 (0.1)	0.1 (0.1)	0.4 (0.1)	T
Yellow perch	1.3 (0.2)	1.3 (0.2)	1.4 (0.3)	2.2 (0.5)	2.4 (0.7)

Seventeen species of age-0 fishes or small littoral fishes (minnows and darters) were collected with seines in 2003 (Table 5). Gizzard shad was the most abundant species in seine catches for the first time since the standard seining survey was initiated in 1981. Gizzard shad was followed by white bass, emerald shiner, and spottail shiner, in order of decreasing abundance in seine catches. Gizzard shad

were sampled with seines for the first time in Lake Oahe in 2001 and mean shad CPUE was the second highest of species collected in 2002. The catch per seine haul during 2003, for all species collected except gizzard shad, was within ranges previously observed. White bass reproduction appears to fluctuate greatly among years with high years of production occurring in 1999, 2001, and 2003 (Table 5), as indicated by mean seine haul CPUE values greater than 45 fish/haul during these years.

Table 5. Mean catch per seine haul for fish species in Lake Oahe, South Dakota, 1999-2003. Catches are for age-0 fishes except where noted. Trace (T) indicates values less than 0.05. Standard errors are in parenthesis.

Species	Year				
	1999	2000	2001	2002	2003
Bigmouth buffalo	0.0	0.1 (0.1)	0.1 (0.1)	0.0	0.0
Black crappie	4.2 (0.5)	0.9 (0.7)	0.0	0.1 (0.1)	0.0
Brassy minnow*	T	0.1 (0.1)	0.3 (0.2)	0.0	0.0
Channel catfish	0.0	0.0	T	0.1 (0.1)	0.1 (T)
Common carp	0.1 (0.1)	0.0	2.1 (0.9)	1.9 (1.9)	0.1 (T)
Emerald shiner*	10.2 (0.8)	34.8(17.3)	83.3 (47.1)	50.0 (20.8)	35.0 (3.6)
Fathead minnow*	0.0	0.1 (0.1)	0.7 (0.5)	0.0	1.2 (0.3)
Flathead chub	0.0	0.0	0.0	0.1 (0.1)	0.0
Freshwater drum	0.4 (0.2)	1.2 (0.9)	1.6 (0.9)	21.6 (14.1)	2.9 (0.5)
Gizzard shad	0.0	0.0	2.9 (2.9)	46.2 (27.3)	322.2 (41.1)
Golden shiner	0.0	0.0	0.1 (0.1)	0.0	0.0
Goldeye	0.1 (0.1)	0.0	0.0	0.0	T
Johnny darter*	0.1 (0.1)	0.2 (0.1)	0.4 (0.3)	0.1 (T)	0.5 (0.1)
Lake herring	0.0	0.0	1.2 (0.8)	0.0	0.0
Largemouth bass	0.0	0.0	0.7 (0.5)	0.0	0.0
Northern pike	0.0	0.0	0.0	0.0	0.0
River carpsucker	T	0.0	1.1 (0.7)	0.1 (0.1)	0.2 (T)
Red shiner*	0.0	T	0.0	0.0	0.0
Shorthead redhorse	0.0	T	0.1 (0.1)	0.0	0.1 (T)
Silvery minnow	0.0	0.0	0.2 (0.2)	2.1 (1.9)	0.0
Smallmouth bass	5.1 (0.6)	1.4 (0.5)	3.9 (1.6)	0.9 (0.3)	0.2 (T)
Smallmouth buffalo	T	0.9 (0.6)	0.0	0.0	0.0
Spottail shiner*	18.8 (1.4)	17.1 (6.2)	15.2 (7.9)	14.5 (5.9)	24.5 (2.5)
Suckermouth minnow*	0.5 (0.3)	0.0	0.0	0.0	0.0
Walleye	0.1 (0.1)	0.0	0.2 (0.1)	T	0.1 (T)
White bass	66.8 (2.6)	18.1 (5.8)	66.4 (38.9)	21.0 (7.3)	46.3 (7.9)
White crappie	0.4 (0.3)	0.1 (0.0)	0.6 (0.3)	0.1 (0.1)	0.1 (T)
White sucker	2.5 (0.6)	0.3 (0.2)	1.4 (0.7)	0.0	0.5 (0.1)
Yellow perch	55.4 (2.5)	1.6 (0.8)	37.4 (22.8)	0.5 (0.3)	4.2 (0.8)

* Denotes all ages of fish included.

Population Parameters for Walleye

Mean walleye CPUE in the standard coolwater gill net survey decreased from 18.3 walleye/net-night in 2002 to 13.8 walleye/net-night in 2003 (Table 4). Even when CPUE was weighted by reservoir volume to account for changes in volume from 2002 to 2003, mean CPUE of walleyes decreased from 2002-2003. Mean walleye CPUE for upper Lake Oahe in 2003, at 14.9 fish/net-night, was significantly lower than other years in the 1997-2003 period (Lott et al. 2003a; Table 6). Mean CPUE of walleye in the standard gill net survey was similar for middle and upper Lake Oahe in 2003, at 16.6 and 14.9 fish/net-night, respectively. Mean walleye CPUE in the 2003 gill net

survey was significantly lower in lower Lake Oahe than other zones (Table 6). Mean walleye CPUE was higher in upper Lake Oahe than other zones of the reservoir for all years in the 1997-2003 period, except 1998 and 2003.

Table 6. Mean walleye catch per unit effort (No./net-night) in coolwater gill net sets for lower, middle, and upper zones of Lake Oahe, South Dakota, 1997-2003. Values within a year with no letters in common are significantly different at $P<0.05$. Comparisons were only made within years.

Year	Zone		
	Lower	Middle	Upper
1997	21.5 a	22.1 a	31.6 b
1998	23.4 a	19.3 a	21.1 a
1999	17.4 a	17.9 a	29.3 b
2000	13.1 a	17.6 a	27.4 b
2001	8.9 a	9.1 a	26.6 b
2002	9.7 a	12.5 a	32.8 b
2003	9.7 a	16.6 b	14.9 b

Examination of walleye age distribution data from scale and otolith analyses, for standard coolwater gill net surveys from 1999-2003 (Tables 7 and 8), illustrates the dominance of the 1999- and 2001-year classes in the 2003 Lake Oahe walleye population. Based on a mean age-0 walleye CPUE of 0.2 fish/net-night in the 2003 standard gill net survey, 2003 appears to be a low year for walleye production in Lake Oahe (Table 7). As with overall walleye abundance, annual production of walleye is usually highest in the upper zone of Lake Oahe and decreases in a downstream direction. Early indications suggest that the 2001 walleye year class may be comparable to the 1999 year class, as illustrated by CPUE values at ages 0-2.

Comparison of mean length-at-age-at-time-of-capture estimates (Table 9) for 2002 and 2003 illustrate that both scales and otoliths appear to be valid aging structures for fish less than 400-mm or age-4 and younger. However, for fish longer than 400-mm, higher mean length-at-age estimates for scale samples suggests these fish are being under-aged (Table 10). Casselman (1990) determined that for older fish, scales can be resorbed or erode and fail to provide an accurate record of age, while otoliths continue to grow and record annual growth. Isermann et al. (2003) suggested using otoliths for age determination for all ages of walleyes because of higher aging precision and shorter processing time than scale or dorsal spine samples. Therefore, it is recommended that age and growth data generated from otolith aging be used to interpret growth for walleyes longer than 400 mm. Maximum ages of walleyes in the 2003 gill net survey, as estimated from scales and otoliths, were nine and 14, respectively (Table 10).

In addition to improving the accuracy of growth data for walleye in Lake Oahe, otolith aging may result in a more accurate age structure estimate for use in calculating mortality rate estimates and monitoring the relative abundance of walleye year classes over time. As an example, strong 1994-1996 walleye year classes are better represented in otolith-generated age frequencies than for scale-generated age frequencies (Tables 7 and 8).

Walleye condition in 2003, for the total walleye sample, increased in lower Lake Oahe from 2002, while values for middle and upper Lake Oahe, for the total sample, were unchanged from 2002 (Table 11).

Table 7. Age distribution of walleye collected from Lake Oahe, South Dakota with standard coolwater gill net sets, by zone, as determined by aging scales. Mean age excludes age-0 fish. Year refers to walleye year class, CPUE is catch per unit effort (No./net-night), and T (trace) indicates values <0.05.

Scales

1999

Age	0	1	2	3	4	5	6	7	8	9	10	Mean age
Year	99	98	97	96	95	94	93	92	91	90	89	
Low	3	28	45	71	136	20	2	2	7	0	0	3.4
Mid	7	12	49	98	115	18	7	7	4	1	1	3.5
Up	39	41	22	99	292	24	6	1	0	1	0	3.5
All	49	81	116	268	543	62	15	10	11	2	1	3.5
CPUE	0.9	1.5	2.2	5.0	10.0	1.2	0.3	T	T	T	T	

2000

Age	0	1	2	3	4	5	6	7	8	9	10	Mean age
Year	00	99	98	97	96	95	94	93	92	91	90	
Low	2	23	30	56	66	47	12	0	0	0	0	3.5
Mid	3	40	22	74	92	67	14	1	0	2	1	3.6
Up	22	107	47	42	50	218	6	0	0	0	0	3.5
All	27	170	99	172	208	332	32	1	0	2	1	3.5
CPUE	0.5	3.1	1.8	3.2	3.9	6.1	0.6	T	0	T	T	

2001

Age	0	1	2	3	4	5	6	7	8	9	10	Mean age
Year	01	00	99	98	97	96	95	94	93	92	91	
Low	2	7	40	13	36	27	27	5	1	0	0	3.9
Mid	14	20	41	20	26	22	13	2	3	0	2	3.4
Up	50	67	159	62	54	58	32	3	1	0	1	3.0
All	66	94	240	95	116	107	72	10	5	0	3	3.3
CPUE	1.2	1.7	4.4	1.8	2.1	2.0	1.3	0.2	0.1	0.0	0.1	

2002

Age	0	1	2	3	4	5	6	7	8	9	10	Mean age
Year	02	01	00	99	98	97	96	95	94	93	92	
Low	1	26	7	49	30	25	23	5	2	0	0	3.7
Mid	0	25	39	44	49	31	16	10	1	0	0	3.5
Up	9	122	135	137	48	44	23	25	5	0	0	2.9
All	4	173	176	227	136	104	63	37	8	0	0	3.2
CPUE	0.1	3.2	3.3	4.2	2.5	1.9	1.2	0.7	0.1	0.0	0.0	

2003

Age	0	1	2	3	4	5	6	7	8	9	10	Mean age
Year	03	02	01	00	99	98	97	96	95	94	93	
Low	5	34	43	21	20	25	17	5	4	1	0	3.3
Mid	1	33	166	35	32	16	7	3	5	1	0	2.7
Up	7	25	104	61	41	19	9	0	0	0	0	2.8
All	13	93	311	118	94	61	33	8	9	2	0	2.9
CPUE	0.2	1.7	5.8	2.2	1.7	1.1	0.6	0.1	0.2	0.0	0.0	

Table 8. Age distribution of walleye collected from Lake Oahe, South Dakota with standard coolwater gill net sets, by zone, as determined by aging otoliths. Mean age excludes age-0 fish. Year refers to walleye year class, CPUE is catch per unit effort (No./net-night), and T (trace) indicates values <0.05.

Otoliths													
2002													
Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean age**
Year	**02**	**01**	**00**	**99**	**98**	**97**	**96**	**95**	**94**	**93**	**92**	**91**	
Low	0	32	7	49	30	25	23	5	2	0	0	0	3.6
Mid	0	31	39	44	49	31	16	11	1	1	0	0	3.5
Up	3	128	135	137	48	44	23	25	5	0	0	0	2.9
All	3	193	176	227	136	104	63	38	8	1	0	0	3.2
CPUE	0.1	3.5	3.3	4.2	2.5	1.9	1.2	0.7	0.1	T	0.0	0.0	
2003													
Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Mean age**
Year	**03**	**02**	**01**	**00**	**99**	**98**	**97**	**96**	**95**	**94**	**93**	**92**	
Low	5	27	53	15	19	7	10	13	22	3	1	0	3.7
Mid	1	31	176	18	31	9	8	11	14	0	0	1	2.8
Up	7	21	102	25	36	10	10	20	34	4	0	0	3.6
All	13	85	321	61	87	26	28	44	70	7	1	1	3.3
CPUE	0.2	1.6	6.0	1.1	1.6	0.5	0.5	0.8	1.3	0.1	T	T	

Table 9. Mean walleye length at time of capture (August), as determined from scales and otoliths, for fish captured during the 2002 and 2003 standard coolwater gill net surveys.

Structure	**Year**		**Length at age at capture (mm)**								
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Scales	**2002**	**N**	137	154	196	118	90	56	32	7	0
		Mean	219	306	366	390	409	430	455	497	---
Otoliths	**2002**	**N**	97	87	121	45	58	45	65	5	---
		Mean	227	322	373	393	412	412	435	450	---
Scales	**2003**	**N**	93	311	118	94	61	33	8	9	2
		Mean	235	287	376	415	448	495	523	532	603
Otoliths	**2003**	**N**	77	295	60	87	26	28	44	69	7
		Mean	229	284	371	409	424	451	441	454	496

Table 10. Comparison of walleye ages determined from interpretation of scale and otolith growth patterns for walleye collected in the August 2003 gill net sample.

Age determined from otoliths	Age determined from scales								
	1	2	3	4	5	6	7	8	9
1	75	2							
2	15	265	15						
3		14	38	5					
4		1	40	34	4	1			
5				11	9				
6				10	10	7	1		
7			5	14	12	10		1	
8			5	12	23	10	6	8	1
9				1	1	3			1
10						1			
11							1		
12									
13									
14						1			

Mean back-calculated length at age data (Table 12) and mean incremental annual growth estimates (Table 13), from scale analysis, document that walleye growth rates slowed considerably from the 1991-1995 (Johnson et al. 1997) to the 1997-2002 period (Lott et al. 2003a). For the complete Lake Oahe sample, mean back-calculated length at age 4 for the 1991 year class in 1995 was 447 mm (Johnson et al. 1996), 90-mm longer than the mean back-calculated length at age 4 for the 1998 year class in 2002 (Table 12). Low growth increments during the 1997-2003 period(Tables 12 and 13) resulted in low replacement of larger walleye harvested by anglers or dying from natural causes (Lott et al. 2003a).

However, there are indications that walleye growth rates are increasing. Because walleye appear to be under-aged when age is determined from scales, incremental growth values determined from otolith age determination offer the best estimate of growth added during the 2002-2003 period. Mean length of walleye in the 1994 year class increased from 450 mm in 2002 (age 8) to 496 mm in 2003 (age 9) and mean length of fish in the 1995 year class increased from 435 mm in 2002 (age 7) to 454 mm in 2003 (age 8; Table 9).

Table 11. Mean walleye relative weight (*Wr*), by length class, for Lake Oahe, South Dakota, 1997-2003. N is the number of fish used in calculations. Within length classes, values with the same letter code are not significantly different from one another at the *P*=0.05 level of significance. Values for the total sample for 2002 and 2003 are only for stock-length-and-longer fish.

Lower Oahe

Year	Stock-Quality		Quality-Prefer.		Preferred		Total	
	N	Wr	N	Wr	N	Wr	N	Wr
1997	178	90 a	131	88 a	36	87 a	345	89 a
1998	256	81 b	66	81 bc	30	80 bc	351	81 b
1999	220	79 bc	67	80 bc	11	71 b	298	79 e
2000	170	78 c	40	77 c	1	68 ab	211	77 e
2001	105	84 d	39	84 bd	6	81 ab	150	84 cd
2002	61	82 bd	81	81 bc	2	84 ab	144	82 bd
2003	65	84 d	68	86 ad	18	85 ac	151	85 c

Middle Oahe

Year	Stock-Quality		Quality-Prefer.		Preferred		Total	
	N	Wr	N	Wr	N	Wr	N	Wr
1997	201	80 a	33	78 a	25	81 a	259	80 a
1998	187	76 c	23	79 ab	5	75 ab	210	77 c
1999	222	82 ab	39	80 a	17	72 b	278	81 ad
2000	240	75 c	24	75 b	4	68 ab	268	79 c
2001	103	81 ab	21	83 ac	5	76 ab	129	81 b
2002	104	82 b	75	81 ac	6	83 ab	185	82 bd
2003	167	82 b	69	85 c	9	79 ab	245	82 b

Upper Oahe

Year	Stock-Quality		Quality-Prefer.		Preferred		Total	
	N	Wr	N	Wr	N	Wr	N	Wr
1997	178	90 d	52	80 a	25	82 a	255	87 a
1998	248	80 a	3	80 a	6	76 a	256	79 b
1999	428	83 b	11	83 a	4	77 a	443	83 c
2000	316	80 a	43	75 b	1	73 a	360	79 b
2001	334	88 c	62	85 c	0	--	396	87 a
2002	217	79 a	196	78 a	0	--	413	79 b
2003	133	79 a	80	75 b	2	68 a	215	78 b

Table 12. Mean back-calculated total lengths (mm) at annulus, by zone, for each year class of walleye in Lake Oahe gill net catches in 2003, as determined from scale analysis.

Lower Oahe

Year class	Age	N	Back-calculated age								
			1	2	3	4	5	6	7	8	9
2002	1	34	159								
2001	2	43	152	235							
2000	3	21	170	285	352						
1999	4	20	162	243	321	377					
1998	5	25	189	278	346	397	439				
1997	6	17	211	298	362	406	445	477			
1996	7	5	175	263	333	372	411	458	488		
1995	8	4	173	245	336	386	418	453	479	510	
1994	9	1	241	313	405	443	480	510	578	630	649
All classes			181	270	351	397	439	475	515	570	649
N		170	170	136	93	72	52	27	10	5	1

Middle Oahe

Year class	Age	N	Back-calculated age								
			1	2	3	4	5	6	7	8	9
2002	1	33	153								
2001	2	166	149	230							
2000	3	35	175	270	331						
1999	4	32	187	275	347	395					
1998	5	16	188	267	329	389	427				
1997	6	7	183	258	318	372	427	468			
1996	7	3	146	220	291	375	426	482	513		
1995	8	5	163	237	302	346	389	424	468	510	
1994	9	1	181	234	283	323	390	435	477	509	538
All classes			169	249	315	367	412	452	486	509	538
N		298	298	265	99	64	32	16	9	6	1

Upper Oahe

Year class	Age	N	Back-calculated age								
			1	2	3	4	5	6	7	8	9
2002	1	25	147								
2001	2	104	149	231							
2000	3	61	156	257	335						
1999	4	41	170	252	319	376					
1998	5	19	154	233	293	341	388				
1997	6	9	167	259	334	380	421	462			
All classes			157	246	320	365	405	462			
N		259	259	234	130	69	28	9			

Total Oahe

Year class	Age	N	Back-calculated Age								
			1	2	3	4	5	6	7	8	9
2002	1	93	154								
2001	2	311	149	231							
2000	3	118	164	266	336						
1999	4	94	174	258	329	383					
1998	5	61	179	263	327	379	421				
1997	6	33	193	279	345	391	435	471			
1996	7	8	164	247	317	373	417	467	498		
1995	8	9	167	241	317	364	402	437	473	510	
1994	9	2	211	274	344	383	435	473	528	570	594
All classes			173	257	331	379	422	462	499	540	594
N		729	729	636	325	207	113	52	19	11	2

Table 13. Average annual increments of back-calculated lengths (mm) for each year class of walleye collected from Lake Oahe in 2003, as determined from scale analysis.

Lower Oahe

Year Class	Age	N	Annual growth increment								
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
2002	1	34	159								
2001	2	43	152	83							
2000	3	21	170	115	67						
1999	4	20	162	81	78	56					
1998	5	25	189	89	68	51	42				
1997	6	17	211	87	64	44	39	32			
1996	7	5	175	88	70	39	39	47	30		
1995	8	4	173	72	91	50	32	35	26	31	
1994	9	1	241	72	92	38	37	30	68	52	19
All classes			181	89	81	46	42	36	40	55	79
N		170	170	136	93	72	52	27	10	5	1

Middle Oahe

Year Class	Age	N	Annual growth increment								
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
2002	1	33	153								
2001	2	166	149	81							
2000	3	35	175	95	61						
1999	4	32	187	88	72	48					
1998	5	16	188	79	62	60	38				
1997	6	7	183	75	60	54	55	41			
1996	7	3	146	74	71	84	51	56	31		
1995	8	5	163	74	65	44	43	35	44	42	
1994	9	1	181	53	49	40	67	45	42	32	29
All classes			169	80	66	52	45	40	34	23	29
N		298	298	265	99	64	32	16	9	6	1

Upper Oahe

Year Class	Age	N	Annual growth increment								
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
2002	1	25	147								
2001	2	104	149	82							
2000	3	61	156	101	78						
1999	4	41	170	82	67	57					
1998	5	19	154	79	60	48	47				
1997	6	9	167	92	75	46	41	41			
All classes			157	89	74	45	40	57			
N		259	259	234	130	69	28	9			

Table 13 continued…

Total Oahe										
Year Class	Age	N	Annual growth increment							
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
2002	1	93	154								
2001	2	311	149	82							
2000	3	118	164	102	70						
1999	4	94	174	84	71	54					
1998	5	61	179	84	64	52	42				
1997	6	33	193	86	66	46	44	36			
1996	7	8	164	83	70	56	44	50	31		
1995	8	9	167	74	76	47	38	35	36	37	
1994	9	2	211	63	70	39	52	38	55	42	24
All classes			173	84	74	48	43	40	37	41	54
N		729	729	636	325	207	113	52	19	11	2

The estimated annual mortality rate for 2002 and 2003 pooled age frequency data (generated from scales), at 50%, was the second lowest of the pooled samples shown, after the 2001-2002 pooled data estimate (Table 14). However, mortality estimates may reflect variable year class strength more than actual changes in annual mortality. The estimate of annual mortality generated for 2002-2003 pooled age frequency data from otolith analysis, at 45%, was similar to the estimate generated from scale data of 50%. Mortality estimates generated from age frequencies determined from otolith samples might generally be lower than for estimates generated from scale samples because older fish are better represented in otolith-generated age frequencies.

Table 14. Estimates of annual survival (S), annual mortality (A), and instantaneous mortality (Z) rates, for age-2-and-older walleye from Lake Oahe, South Dakota, as determined from scale and otolith age interpretation. Years indicates which years of annual coolwater gill net survey data were combined for analysis.

Years	S	A	Z
Scales			
1996-1997	0.43	0.57	0.844
1997-1998	0.41	0.59	0.882
1998-1999	0.43	0.57	0.833
1999-2000	0.36	0.64	1.012
2000-2001	0.36	0.64	1.029
2001-2002	0.59	0.41	0.531
2002-2003	0.50	0.50	0.702
Otoliths			
2002-2003	0.55	0.45	0.604

Proportional stock density values decreased from 2002 to 2003 in upper and middle Lake Oahe because walleyes from the 2001-year class recruited to stock length and many of the fish in the 1999 year class were less than quality length, in the August 2003 gill net sample (Table 15). In lower Lake Oahe, where annual walleye

recruitment is generally lower, PSD values for 2002 and 2003 were similar. The PSD value for the overall Lake Oahe 2003 gill net sample, of 40, is within the objective range for balanced populations of 30-60 (Anderson and Weithman 1978). The objective range for PSD of 30-60, as outlined in the LOSP, was met for the second straight year in 2003. Relative stock density values, for gill net samples from all zones of Lake Oahe, increased from 2002 to 2003, with the RSD-P value for the overall sample being 5 in 2003 (Table 15). However, the RSD-P objective of ≥10 has not been met since 1997.

Examination of Figure 2 also illustrates the increase in quality of the Lake Oahe walleye population size distribution and the fact the population is more balanced than during the 1998-2001 period. Mean CPUE of walleye ≥457 mm in length increased from 2002 to 2003 and was higher than any year during the 1998-2003 period.

Peaks in the length frequency histogram for upper lake Oahe from 250-270 mm and from 360-380 mm correspond to the 2001 and 1999 year classes, respectively (Figure 3). As is typically the case, recruitment of walleyes to age-1 is highest in upper Lake Oahe. The peak in the length frequency histogram for middle Lake Oahe from 280-310 mm corresponds to the 2001 year class and reflects faster growth of fish in the 2001 year class in middle than upper Lake Oahe. The 1999 year class is better represented in the upper Lake Oahe sample than in the middle Oahe sample.

Table 15. Walleye proportional stock density (PSD) and relative stock density of preferred-length and memorable-length (RSD-P and RSD-M) fish for gill net catches, from Lake Oahe, South Dakota, 1997-2003.

Year	Zone											
	Lower			Middle			Upper			Total		
	PSD	RSD-P	RSD-M	PSD	RSD-P	RSD-M	PSD	RSD-P	RSD-M	PSD	RSD-P	RSD-M
1997	49	11	1	22	10	2	35	10	0	35	10	1
1998	27	9	1	13	2	0	4	2	0	16	5	1
1999	26	4	1	20	6	2	3	1	0	15	3	1
2000	19	0	0	11	2	1	12	0	0	14	1	0
2001	30	4	1	20	3	2	16	0	0	20	2	1
2002	58	1	0	44	3	1	47	0	0	49	1	0
2003	57	12	1	31	4	0	38	1	0	40	5	0

When standard August gill net survey walleye CPUE and length frequency histograms are examined for 2002 (Lott et al. 2003a) and 2003, it becomes apparent that movement of walleyes from upper to middle Lake Oahe, may have contributed to some of the changes in these parameters. Mean walleye CPUE in middle Lake Oahe increased from 12.5 walleye/net-night in 2002 to 16.6 walleye/net-night in 2003, while mean CPUE in upper Oahe decreased from 32.8 to 14.9 walleye/net-night during the same period (Table 6). In addition to the fact walleye CPUE increased in middle Oahe as it decreased in upper Oahe, the CPUE of walleyes from the 2001 year class was higher in upper Lake Oahe in 2001 and 2002 but higher in middle Oahe in 2003 (Tables 7 and 8). The high abundance of age-2 walleyes in middle Oahe is illustrated in Figure 3 (280-310 mm), and may have resulted from downstream movement of fish produced in upper Oahe because of decreasing water elevations in the reservoir, availability of food, or natural dispersion patterns.

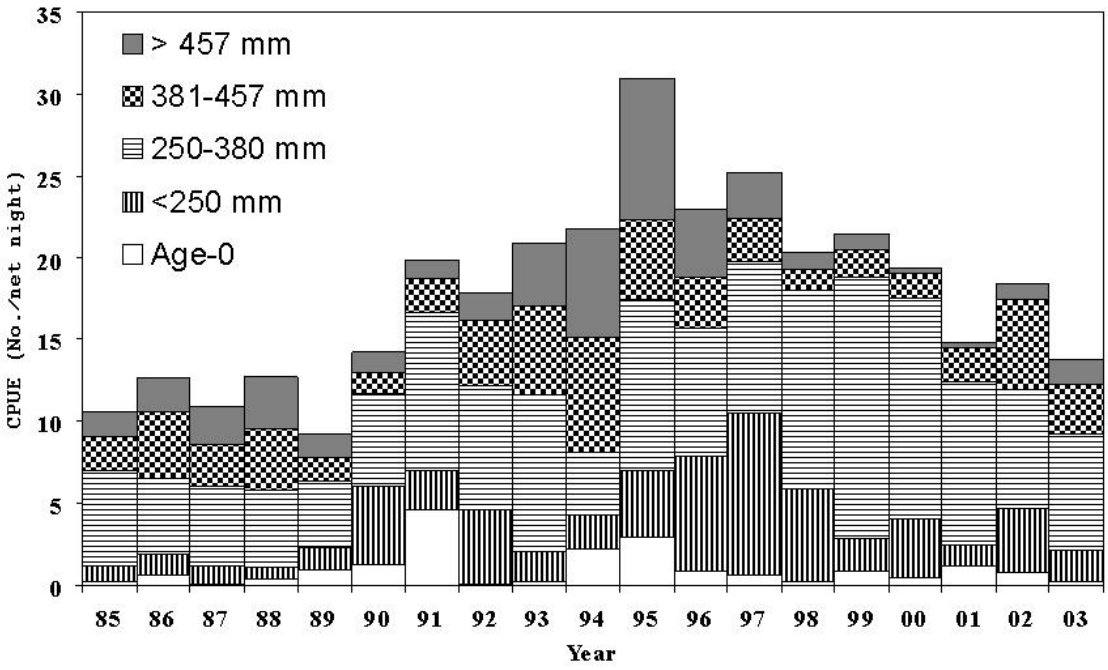


Figure 2. Length structure, in terms of catch per unit effort (CPUE), of Lake Oahe walleye sampled in the standard coolwater gill net survey, 1985-2003.

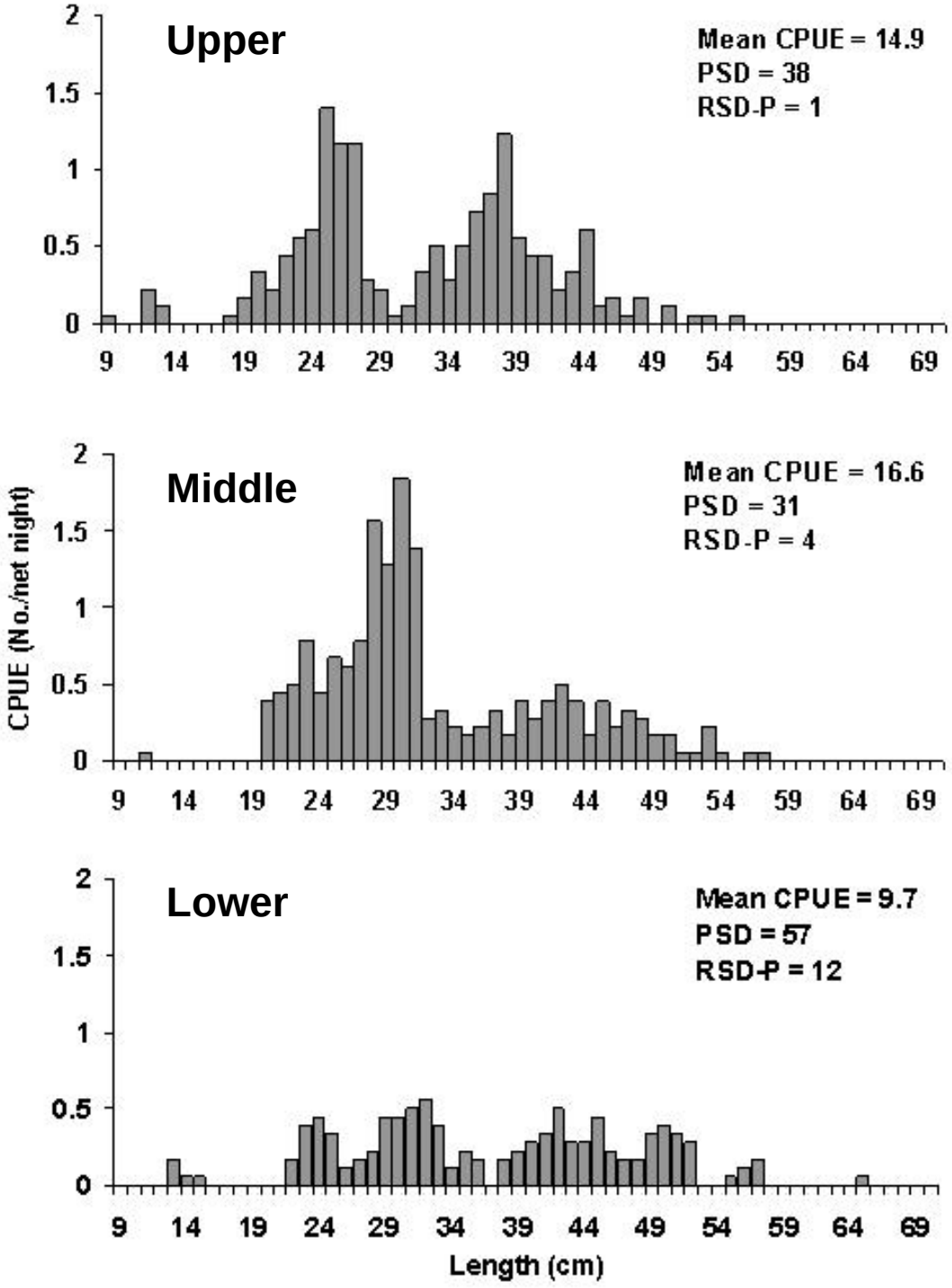


Figure 3. Length frequencies of walleye, in terms of catch per unit effort (CPUE), by zone, for fish collected during the standard coolwater gill net survey in 2003.

Population Parameters for Channel Catfish

Proportional stock density for the overall Lake Oahe 2003 gill net sample of channel catfish, at 46, was within the range previously observed (Table 16). Structural indices of the Lake Oahe channel catfish population generally vary little among years due to slow growth, consistent recruitment, and low exploitation (Lott et al. 2003a). Mean *Wr* values for channel catfish are low, with values for the 1997-2003 period ranging from 76 to 83 (Table 16). Channel catfish growth rates have slowed considerably since the impoundment of Lake Oahe (Starostka and Nelson 1974; Lott et al. 2003a). Quality length for channel catfish is 410 mm, or approximately 16 inches. Therefore, 46 % of the channel catfish sampled in the standard gill net survey in 2003 were longer than 16 inches (Figure 4) but angler use and harvest of this species remained low. Mean CPUE of channel catfish in the 2003 standard gill net survey, at 15.6, was the highest of all species sampled (Table 4).

Table 16. Channel catfish proportional stock density (PSD), relative stock density of preferred- and memorable-length (RSD-P and RSD-M) fish, and relative weight (*Wr*) for 1997-2003, from Lake Oahe, South Dakota. Mean *Wr* values for 2002 and 2003 are for stock-length fish only

Year	PSD	RSD-P	RSD-M	Wr	Sample size
1997	56	4	0	83	411
1998	54	2	0	78	391
1999	51	1	0	79	428
2000	52	1	0	77	452
2001	44	1	0	77	493
2002	42	0	0	78	533
2003	46	2	0	76	424

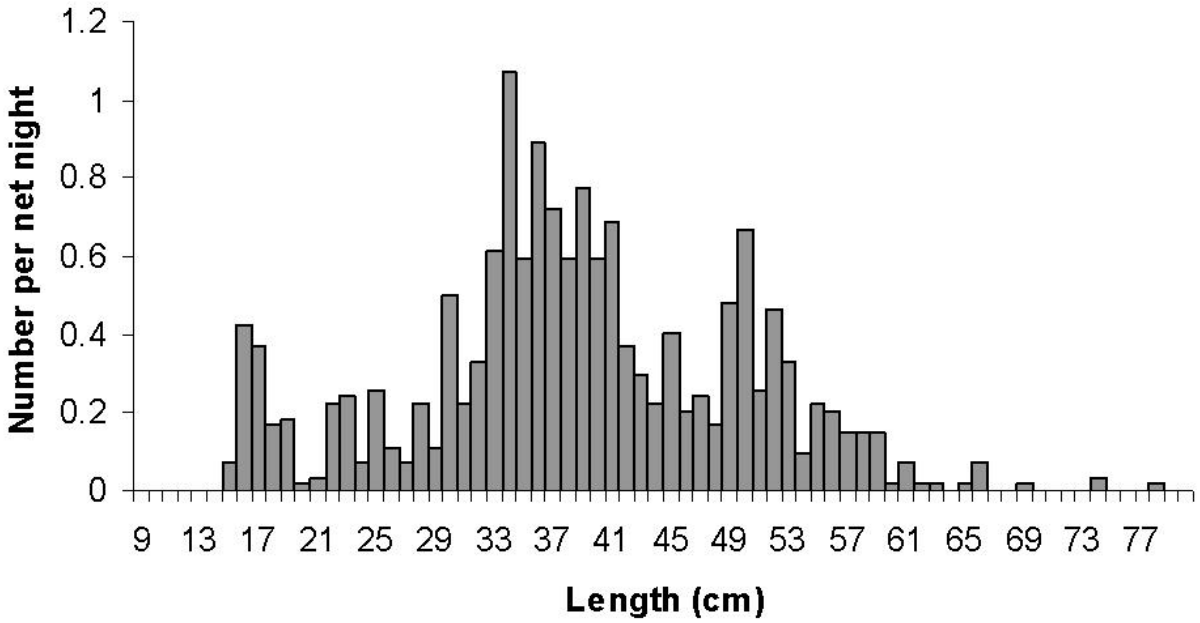


Figure 4. Length frequency of channel catfish, in terms of catch per unit effort (CPUE), collected during the standard coolwater gill net survey in 2003.

LARVAL TRAWLING

Larval rainbow smelt densities were the highest measured since 1997 (Table 17.), increasing for the second consecutive year. Water level fluctuations on Lake Oahe during the critical period of smelt spawning, egg incubation, and post-hatch survival were improved in 2003 when compared with water level fluctuations in 2002. Despite the lack of significant amounts of flooded vegetation, larval yellow perch densities appear to be trending upward. Larval lake herring densities were similar to years prior to the peak density measured in 2001. Spottail shiner densities were substantially lower than recent years, except 2002. The court order, which held water levels stable during rainbow smelt spawning and egg incubation, was removed prior to spottail shiner spawning. Water levels in Lake Oahe subsequently fell rapidly, likely negatively affecting spottail shiner spawning and egg incubation. Walleye larvae were not sampled during 2003.

Table 17. Mean larval densities (No./100 m^3) of selected prey species, by reservoir zone, in Lake Oahe, South Dakota, during late May and early June, 1995-2003. Trace (T) indicates a value less than 0.05.

Species	Year	Zone			Lake Oahe
		Lower	Middle	Upper	
Rainbow Smelt	1995	165.9	24.1	131.2	107.1
	1996	9.2	11.4	58.1	26.2
	1997	31.7	8.6	0.1	13.5
	1998	9.3	2.1	0	3.8
	1999	1.0	0.03	0	0.4
	2000	9.3	0.3	0.1	3.3
	2001	2.5	T	0	0.8
	2002	4.7	2.8	6.7	4.7
	2003	12.1	20.5	1.1	11.2
Yellow Perch	1995	42.6	17.7	15.9	25.4
	1996	11.8	2.8	30.0	14.9
	1997	26.3	26.6	77.8	43.6
	1998	19.4	10.7	10.7	13.6
	1999	3.3	3.3	3.3	3.3
	2000	0.4	1.6	1.2	1.1
	2001	0	0.2	0.1	0.1
	2002	1.9	1.8	6.7	3.5
	2003	1.3	6.1	6.0	4.5
Lake Herring	1995	T	0.1	0.4	0.2
	1996	0.1	0.3	0	0.1
	1997	0.3	0.9	0.2	0.5
	1998	0.2	1.4	T	0.6
	1999	0.2	1.0	0.9	0.7
	2000	0	0.1	0	0.02
	2001	1.7	9.8	3.6	5.0
	2002	0.7	0.9	0.2	0.6
	2003	0.4	0.6	T	0.4
Spottail Shiner	1995	4.4	0	2.6	2.3
	1996	0.3	0.6	0.1	0.3
	1997	1.6	0.1	2.3	1.3
	1998	T	T	0	T
	1999	2.6	5.2	2.7	3.5
	2000	0.5	3.3	0	1.3
	2001	0.4	5.0	11.2	5.6
	2002	0.1	0.1	0	0.1
	2003	1.5	1.5	0.3	1.1

ANGLER USE AND SPORT FISH HARVEST SURVEYS

ANGLER USE AND HARVEST

Estimated fishing pressure for the April-October 2003 daylight period, at 651,557 h, was the second lowest of years for which an April-October survey was conducted (Table 18) and was 76% of the 2002 estimate of 856,059 h. Estimated angler trips were also the second lowest of years for which April-October estimates were generated, at 121,107 trips, 69% of the 2002 estimate of 174,706 trips. The only year for which lower estimates of fishing pressure and angler trips were generated was 2000 (Table 18). The highest values estimated for fishing pressure and angler trips, for the April-October daylight period, occurred in 1996, at 1,968,525 h and 338,880 trips. Estimated fishing pressure for 2003 was 33% of the record estimate and the estimated number of angler trips was 36% of the record estimate.

Table 18. Angler use and harvest statistics from creel surveys conducted on Lake Oahe, South Dakota, for the April-October daylight period, except where noted.

Year	Fishing pressure (h)	Angler trips (No.)	Fish harvest (No.)	Walleye harvest (No.)	Reference
1981*	671,393	124,332	278,127	221,594	Riis (1982)
1982**	1,276,990	228,034	342,682	286,633	Riis (1983)
1983**	784,658	142,665	141,475	95,797	Riis (1984)
1986	1,031,176	190,658	313,199	256,737	Riis and Stone (1989)
1991***	903,777	238,795	193,593	178,492	Fielder et al. (1992)
1992***	1,051,330	210,266	267,746	216,426	Stone et al. (1994)
1993	1,299,344	236,244	318,381	269,392	Stone et al. (1994)
1994	1,189,267	212,597	341,391	288,182	Johnson et al. (1995)
1995	1,695,945	292,404	464,735	367,693	Johnson et al. (1996)
1996	1,968,525	338,880	533,062	438,355	Johnson et al. (1997)
1997	1,617,024	287,011	538,596	475,638	Johnson et al. (1998)
1998	1,781,032	309,744	563,009	484,234	Johnson et al. (1999)
1999	847,359	158,904	328,184	280,305	Lott et al. (2000)
2000	539,188	109,665	267,642	225,041	Lott et al. (2001)
2001	1,014,591	206,638	702,899	632,770	Lott et al. (2002)
2002	856,059	174,706	474,168	383,367	Lott et al. 2003a
2003	651,557	121,107	249,166	181,528	This study

* July-September
** April-September
*** May-October

Estimated fishing pressure peaked during July in 2003, at 238,163 h (Table 19). Approximately 69% of the estimated fishing pressure for the April-October 2003 daylight period occurred during June and July and 92% of the pressure occurred during the May-August period. Estimated fishing pressure was highest in upper Lake Oahe in June and in middle and lower Lake Oahe in July (Tables 19 and 20). The highest percentage of total fishing pressure occurred in middle Lake Oahe, at 43%, followed by upper and middle Lake Oahe, at 32% and 25% of total fishing pressure, respectively (Table 20).

Table 19. Total estimated fishing pressure (angler hours), for the daylight survey period, by month and zone, on Lake Oahe, South Dakota, during 2003. Confidence intervals are in the shaded rows.

Month	Zone			
	Lower	Middle	Upper	Total
April	3,405	4,332	7,617	15,353
95% CI	3,143	3,997	7,747	9,267
May	14,786	19,763	43,470	78,019
95% CI	18,676	24,857	29,411	42,798
June	38,287	88,283	82,753	209,323
95% CI	24,907	35,981	35,987	56,658
July	61,170	130,480	46,513	238,163
95% CI	47,211	92,632	35,231	109,776
August	37,009	25,400	13,938	76,347
95% CI	19,743	17,282	7,413	27,265
Sept.	7,176	8,571	5,499	21,246
95% CI	7,163	3,322	2,390	8,249
Oct.	2,970	3,883	6,251	13,104
95% CI	4,174	3,306	5,786	7,864
Total	**164,804**	**280,712**	**206,041**	**651,557**
95% CI	**60,551**	**104,066**	**59,628**	**134,356**

Estimated fishing pressure per hectare for the April-October 2003 daylight period was 5.8 h/ha (Table 20), based on a surface area for the South Dakota portion of Lake Oahe of 110,660 ha at full pool (1617 msl). However, on July 15, 2003, the elevation of Lake Oahe was approximately 1587 msl and estimated surface area was 81,326 ha. Therefore, actual pressure per hectare for the April-October 2003 period was estimated at 8.0 h/ha.

Of the estimated 249,166 fish harvested during the April-October 2003 daylight period from Lake Oahe, 181,528 (73%) were walleye (Table 21). White bass, channel catfish, northern pike, and smallmouth bass followed walleye in decreasing order of estimated harvest (Table 21, Figure 5).

Table 20. Total estimated angler hours for the April-October daylight period, for boat, shore, and methods combined, by zone, on Lake Oahe, South Dakota, during 2003. Hours per hectare values are based on surface area at full pool.

Zone	Boat			Shore			Combined		
	Hours	%	h/ha	Hours	%	h/ha	Hours	%	h/ha
Lower	158,589	26	3.8	6,215	17	0.2	164,804	25	3.9
Middle	264,767	43	7.8	15,945	42	0.5	280,712	43	8.3
Upper	190,598	31	5.4	15,444	41	0.4	206,042	32	5.9
Tot/Avg	613,954		5.5	37,604		0.3	651,558		5.8

Estimated walleye harvest for the 2003 survey period was the lowest of years for which April-October surveys were conducted (Table 18). Estimated number of walleyes and white bass released during the April-October survey period were similar, at 94,355 and 96,880 fish, respectively (Table 22).

Table 21. Estimated fish harvest, by species and month, for anglers fishing Lake Oahe, South Dakota, April-October, 2003. Species abbreviations used appear in Appendix 1.

Species	Month							
	April	May	June	July	August	Sept.	Oct.	Total
WAE	2,417	25,203	59,842	80,795	10,884	1,591	797	181,528
95% CI	5,217	14,362	17,151	29,678	6,358	1,146	935	38,092
SAR	0	0	52	0	0	12	0	64
95% CI	0	0	103	---	0	---	0	103
WHB	820	8,542	17,769	4,999	1,378	920	768	35,197
95% CI	1,224	7,067	9,205	621	521	697	787	11,744
NOP	2,354	683	628	68	22	0	0	3,755
95% CI	2,660	257	491	---	46	---	0	2,717
FCS	0	0	90	42	152	211	98	592
95% CI	0	0	175	89	---	---	---	196
SMB	0	183	368	1,355	347	55	0	2,308
95% CI	---	89	269	750	81	68	0	809
CCF	799	5,736	6,185	6,572	3,028	602	389	23,311
95% CI	310	6,877	6,263	1,171	2,321	502	443	9,686
RBT	0	0	0	63	25	0	0	87
95% CI	0	0	0	---	---	0	0	---
YEP	0	11	280	459	335	0	0	1,086
95% CI	0	0	472	318	33	---	0	570
FRD	0	0	2	110	287	0	0	399
95% CI	0	0	3	141	780	---	0	793
OTH	442	1	34	179	156	0	26	839
95% CI	---	---	---	---	---	---	---	---
Total	6,832	40,359	85,250	94,642	16,614	3,391	2,078	249,166
95% CI	8,824	12,410	24,374	31,843	8,408	1,580	1,819	43,777

An estimated 502,823 fish were caught during the April-October 2003 daylight period from Lake Oahe and an estimated 249,166 were harvested (50%; Tables 21 and 22). Of the estimated 275,883 walleye caught during the 2003 survey period, approximately 34% were released. Walleye were the most common species caught by anglers, followed by white bass, channel catfish, smallmouth bass, and freshwater drum, in decreasing order of estimated catch (Tables 21 and 22, Figure 5). Estimated catch of walleye, channel catfish, smallmouth bass, and freshwater drum peaked in July in 2003, while estimated catch of white bass peaked in May (Tables 21 and 22).

While approximately 69% of the total estimated fishing pressure occurred during June and July in 2003 (Table 19, approximately 81% of the estimated walleye catch and 77% of the estimated harvest occurred during these two months (Tables 21 and 22). As with fishing pressure, walleye harvest was highest in middle Lake Oahe during the April-October 2003 period, at an estimated 91,960 fish (Tables 23 and 24). However, white bass, northern pike, and channel catfish harvest were highest in upper Lake Oahe during the April-October 2003 period (Table 23).

Table 22. Estimates of fish released, by species and month, for anglers fishing Lake Oahe, South Dakota, April-October, 2003. Species abbreviations used appear in Appendix 1.

Species	Month							
	April	May	June	July	August	Sept.	Oct.	Total
WAE	354	6,902	25,073	56,426	4,535	310	754	94,355
SAR	0	0	58	0	0	0	0	58
WHB	109	26,935	49,568	16,999	1,209	816	1,243	96,880
NOP	1,105	315	165	326	0	29	88	2,029
FCS	0	0	0	0	154	0	0	154
SMB	40	1,752	3,197	4,470	694	861	0	11,013
CCF	792	2,411	4,424	14,089	5,038	434	122	27,311
RBT	0	0	0	0	20	0	0	20
YEP	0	23	468	1,242	195	290	0	2,218
FRD	0	42	2,856	7,058	2,037	47	0	12,040
GOE	28	196	578	1,234	1,220	704	0	3,960
COC	0	231	328	271	34	29	12	906
OTH	0	1,044	754	316	566	36	1	2,713
Total	2,428	39,851	87,469	102,431	15,702	3,556	2,220	253,657

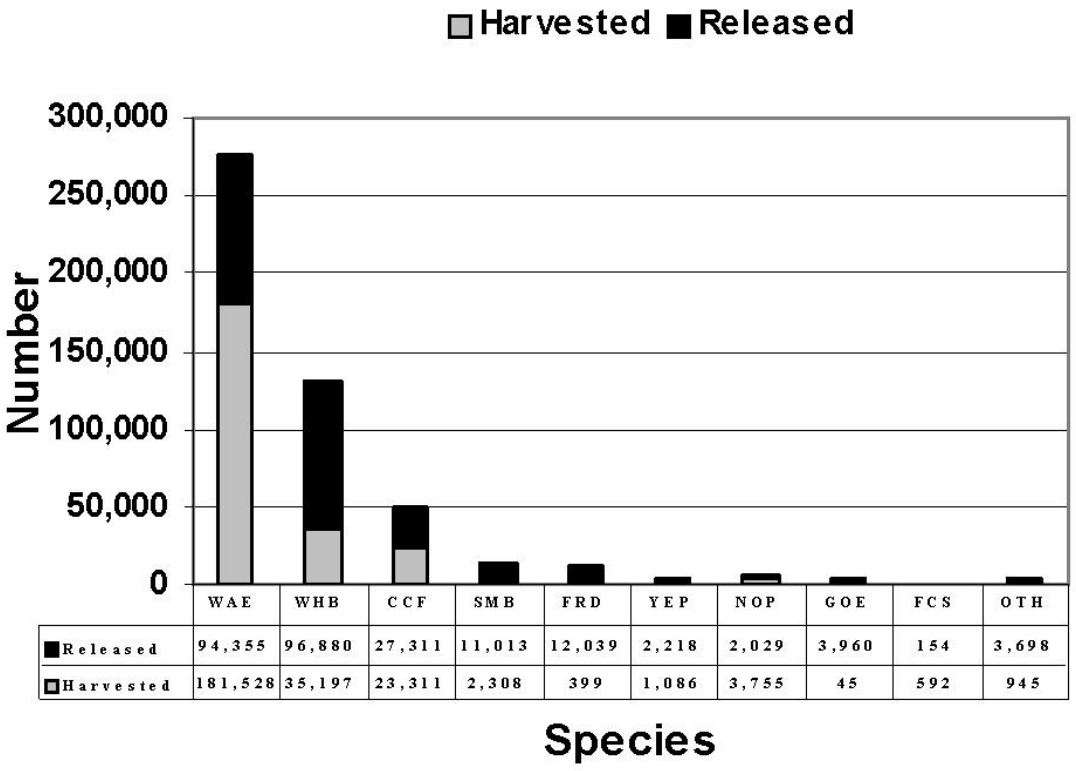


Figure 5. Estimated sport fish harvest for the daylight hours of April-October 2003, in Lake Oahe, South Dakota. Species abbreviations used appear in Appendix 1.

Table 23. Estimated fish harvest, by zone and species, from Lake Oahe, South Dakota, for the daylight hours of April-October 2003.

Species	Zone			
	Lower	Middle	Upper	Total
Walleye	28,215	91,960	61,353	181,528
Sauger	46	18	0	64
White bass	1,098	3,484	30,615	35,197
Northern pike	428	945	2,382	3,755
Chinook salmon	283	308	0	592
Smallmouth bass	445	1,609	255	2,308
Channel catfish	2,103	9,034	12,174	23,311
Rainbow trout	87	0	0	87
Yellow perch	11	942	133	1,086
Other	132	400	706	1,238
Total	32,848	108,700	107,618	249,166

Table 24. Estimated numbers of walleye kept and released, by month and zone, on Lake Oahe, South Dakota, during the daylight hours of April-October 2003.

Month	Zone					
	Lower		Middle		Upper	
	Kept	Released	Kept	Released	Kept	Released
April	7	0	9	0	2,400	354
May	1,007	126	5,192	1,164	19,004	5,612
June	8,294	1,568	29,513	10,012	22,035	13,494
July	14,655	16,514	51,030	29,697	15,110	10,215
August	3,588	1,198	5,678	3,033	1,618	304
September	664	58	538	165	389	88
October	0	0	0	56	797	698
Total	28,215	19,464	91,960	44,127	61,353	30,765

Total	Kept	Released
	181,528	94,356

The mean walleye catch rate for the April-October daylight period decreased from 0.59 fish/h in 2002 (Lott et al 2003) to 0.42 fish/angler-h in 2003. A catch rate of 0.3 fish/angler-h is considered excellent (Colby 1979). The mean catch rate for all species combined decreased from 1.03 fish/angler-h in 2002 (Lott et al. 2003a) to 0.77 fish/angler-h in 2003. Mean hourly catch rates of anglers specifically fishing for walleye, northern pike, smallmouth bass, or channel catfish, were significantly higher than mean catch rates of all anglers for each species (Tables 25 and 26). While the mean hourly catch rate of walleyes for all anglers during the April-October 2003 period was 0.42 walleye/angler-h, the mean catch rate of walleyes by anglers specifically fishing for walleyes was 0.87 walleyes/angler-h. The difference in mean catch rate between the sample of all anglers and those fishing for northern pike, smallmouth bass, and channel catfish was even more pronounced than for walleyes (Tables 25 and 26). As an example, anglers specifically fishing for channel catfish had a mean catch rate of 3.07 catfish/angler-h compared to 0.08 catfish/angler-h for all anglers combined.

Table 25. Estimated harvest, release, and catch rates (fish/angler-h), by species, for anglers fishing Lake Oahe, South Dakota, during the daylight hours of April-October 2003. T (trace) indicates values >0.00 but <0.01.

Species	Harvest rate	Release rate	Catch rate
Walleye	0.28	0.15	0.42
Sauger	T	T	T
White bass	0.05	0.15	0.20
Northern pike	0.01	T	0.01
Chinook salmon	T	T	T
Smallmouth bass	T	0.02	0.02
Channel catfish	0.04	0.04	0.08
Rainbow trout	T	0.00	T
Yellow perch	T	T	0.01
All species	0.39	0.39	0.77

Table 26. Estimated harvest rate, release rate, and catch rate, by species, for anglers specifically fishing for the species listed, on Lake Oahe, South Dakota, during the daylight hours of April-October 2003. Trace (T) indicates values >0.0 but <0.005.

Species Targeted	Harvest rate (fish/angler-h)	Release rate (fish/angler-h)	Catch rate (fish/angler-h)
Walleye	**0.59**	**0.29**	**0.87**
Northern pike	0.26	0.06	0.32
Smallmouth bass	0.00	1.03	1.03
Channel catfish	3.07	0.00	3.07

Mean hourly catch rate, for all species combined, peaked in June and July during 2003 at 0.83 fish/angler-h (Table 27). However, mean harvest and release rates, for all species combined, peaked during May in 2003. Mean hourly catch, harvest, and release rates for walleye peaked during July in 2003 (Table 28) and were lowest in September or October.

Table 27. Estimated harvest, release and catch rates (fish/angler-h), for all species, by month, for anglers fishing Lake Oahe, South Dakota, during the daylight hours of April-October 2003.

Month	Harvest rate	Release rate	Catch rate
April	0.45	0.16	0.60
May	0.52	0.51	1.03
June	0.41	0.42	0.83
July	0.40	0.43	0.83
August	0.22	0.21	0.42
September	0.16	0.17	0.33
October	0.16	0.17	0.33
APR-OCT Mean	**0.38**	**0.39**	**0.77**

Table 28. Estimated harvest, release, and catch rates (walleye/angler-h), for walleye, by month, for anglers fishing Lake Oahe, South Dakota during the daylight hours of April-October 2003.

Month	Harvest rate	Release rate	Catch rate
April	0.16	0.02	0.18
May	0.32	0.09	0.41
June	0.29	0.12	0.41
July	0.34	0.24	0.58
August	0.14	0.06	0.20
September	0.08	0.02	0.09
October	0.06	0.06	0.12
APR-OCT Mean	**0.28**	**0.15**	**0.42**

Mean hourly catch and harvest rates of walleye in Lake Oahe, the percent of walleye caught that were kept, and the mean length of walleye harvested, have changed greatly during the 1992-2003 period, for which annual angler use and harvest surveys were conducted (Table 29). During the 1992-1996 period, mean catch rates of walleye ranged between 0.32 and 0.37 fish/angler-h (Table 29). Mean hourly catch rate of walleye began increasing in 1997 in response to a decrease in available prey, primarily rainbow smelt (Nelson-Stastny 2001). During the 1999-2001 period, mean catch rates of walleye ranged between 0.96 and 1.18 fish/angler-h. Low prey abundance continued through 2003 but mean catch rates of walleye began decreasing after 2000.

During the 1990-1998 period, an April-June 356-mm minimum length limit was in effect for walleye and the daily limit was four fish. High walleye recruitment between 1994 and 1996 created a high abundance of walleye <356-mm in length and increased catchability of the larger walleye in the population occurred because of low prey abundance. In order to protect larger walleye from harvest and increase harvest of walleyes <356-mm in length, the April-June 356-mm minimum length limit was removed. A stipulation that at most one walleye ≥457-mm in length could be included in the daily limit of four fish was also implemented for 1999 and 2000. In response to continued high walleye abundance, high hourly catch rates of walleye, and continued low prey abundance, the daily limit was increased to 14 fish for 2001 in hopes of reducing walleye abundance to reduce predation on existing prey resources. The 2001 regulation included a stipulation that at most four walleyes in the daily limit of 14 could be ≥381-mm TL and only one could be ≥457-mm in length. In 2002 and 2003, the daily limit was 10 fish, with the same size restrictions in effect, as in 2001.

Mean length of walleye harvested by anglers decreased after 1998 in association with the removal of the April-June 356-mm minimum length limit, the high proportion of walleye in the population <356-mm in length, and high daily limits in effect from 2001-2003 (Table 29). The percentage of walleyes caught that were kept did not increase with the removal of the minimum length limit in 1999 but did increase when the daily limit was raised to 14 fish in 2001 and at most four fish in the harvest could be ≥381-mm in length (Table 29).

Mean walleye catch and harvest per angler trip during the 2001-2003 period of high daily limits for Lake Oahe, were highest in 2001 and decreased through 2003 (Table 30). Mean trip length during the 2001-2003 period varied little, ranging between 4.9 and 5.4 h/trip (Lott et. al 2002, 2003a). Therefore, differences in catch per trip are related to decreases in hourly catch rate of walleye during the 2001-2003 period (Table 29). Even though the daily limit for walleye was reduced from 14 fish in 2001 to 10 fish in 2002 and 2003, the reduction in the daily limit had little effect on mean walleye catch and harvest per trip. The reduction in catch and harvest per trip occurred because of decreasing catch and harvest rates from 2001-2003 (Table 29).

Table 29. Estimated mean angler catch and harvest rates (walleye/angler-h) for walleye, the percent of walleye caught that were kept, and the associated mean length (mm), for Lake Oahe, South Dakota, 1992-2003. All values are for the April-October daylight period except where noted.

Year	Catch rate	Harvest Rate	Percent kept	Mean length
1992+	0.37*	0.20*	53	----
1993+	0.32	0.21	65	437*
1994+	0.36	0.24	68	447*
1995+	0.34	0.22	63	468*
1996+	0.34	0.22	65	453*
1997+	0.71	0.29	41	441*
1998+	1.18	0.27	23	410*
1999++	0.97	0.33	34	385
2000++	1.12	0.42	37	379
2001^	0.77	0.62	81	358
2002^^	0.58	0.45	77	380
2003^^	0.42	0.28	66	391

* May-October
\+ April-June 356-mm minimum length, 4 daily, 8 in possession
++ One over 457-mm, 4 daily, 8 in possession
^ At most four over 381-mm, one over 457-mm, 14 daily, 42 in possession
^^ At most four over 381-mm, one over 457-mm, 10 daily, 30 in possession

Angler harvest-per-trip frequencies for the April-October daylight period are presented in Table 31. For the overall sample of fishing trips for the April-October 2003 period, zero walleyes were harvested on 38% of trips, 12% of trips resulted in four or more walleyes being harvested, 4% of trips resulted in six or more walleyes being harvested and, <1% of trips resulted in anglers harvesting a 10-fish limit of walleyes. The highest percentages of anglers harvesting four or more, six or more, or a 10-walleye daily limit occurred in May in upper Lake Oahe and June in middle and lower Lake Oahe (Table 31).

Table 30. Mean walleye catch and harvest per angler trip, by year, month, and zone, for the April-October daylight survey period for Lake Oahe, South Dakota, 2001-2003.

Zone	2001 Catch per angler trip							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	1.34	3.65	2.68	2.99	2.03	1.27	0.66	2.75
Middle	0.37	4.40	5.19	6.06	2.61	1.11	0.10	4.57
Upper	4.87	8.39	5.45	2.88	1.15	1.01	1.11	4.6
Total	2.48	5.54	4.32	4.43	2.00	1.14	1.02	3.87
Zone	2002 Catch per angler trip							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	0.14	0.67	1.67	3.27	0.91	1.30	0.28	1.81
Middle	0.00	0.49	4.50	4.60	1.40	0.71	0.44	3.16
Upper	0.27	0.66	5.17	2.50	1.68	2.61	9.97	3.42
Total	0.16	0.63	3.93	3.55	1.33	1.75	6.03	3.00
Zone	2003 Catch per angler trip							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	0.02	0.34	1.89	3.18	0.67	0.41	0.00	1.83
Middle	0.01	1.82	2.67	3.8	2.00	0.28	0.06	2.60
Upper	1.85	2.34	2.18	2.59	0.74	0.37	1.07	2.18
Total	0.97	1.95	2.33	3.29	1.10	0.43	0.53	2.28
Zone	2001 Harvest per angler trip							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	1.11	3.16	2.20	2.25	1.79	1.20	0.59	2.27
Middle	0.36	3.60	3.90	4.57	2.14	0.87	0.07	3.51
Upper	4.10	7.07	4.65	2.33	0.92	0.85	0.93	3.87
Total	2.09	4.52	3.49	3.36	1.69	0.99	0.86	3.12
Zone	2002 Harvest per angler trip							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	0.11	0.61	1.52	2.54	0.72	0.96	0.28	1.49
Middle	0.00	0.42	3.76	3.35	1.00	0.54	0.31	2.45
Upper	0.23	0.53	4.27	2.02	1.24	1.94	2.44	2.50
Total	0.13	0.54	3.38	2.69	0.99	1.30	1.56	2.32
Zone	2003 Harvest per angler trip							
	April	May	June	July	August	Sept.	Oct.	Total
Lower	0.02	0.30	1.59	1.49	0.50	0.41	0	1.08
Middle	0.01	1.48	2.00	2.41	1.30	0.28	0	1.76
Upper	1.62	1.81	1.35	1.55	0.62	0.37	0.57	1.45
Total	0.84	1.53	1.64	1.94	0.78	0.36	0.27	1.50

Table 31. Walleye harvest per trip frequencies, by month and reservoir zone, for angling parties fishing Lake Oahe during the daylight hours of April-October, 2003.

	Percent of trips with specified average harvest/angler											
	0	**<1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Lower												
APR	96	4	0	0	0	0	0	0	0	0	0	0
MAY	65	15	13	4	4	0	0	0	0	0	0	0
JUN	26	16	23	14	8	5	6	1	0	1	0	1
JUL	26	20	16	15	11	8	2	1	1	0	1	0
AUG	71	7	9	6	3	1	0	1	0	0	0	0
SEP	78	11	6	0	0	0	0	6	0	0	0	0
OCT	100	0	0	0	0	0	0	0	0	0	0	0
TOT	47	14	15	10	7	4	2	1	<1	<1	<1	<1
Middle												
APR	98	2	0	0	0	0	0	0	0	0	0	0
MAY	29	14	29	14	8	5	2	2	0	0	0	0
JUN	13	11	19	15	17	10	7	4	1	1	<1	<1
JUL	11	15	25	17	12	11	2	4	1	<1	0	1
AUG	34	24	15	14	6	4	3	0	0	0	1	0
SEP	68	16	9	7	0	0	0	0	0	0	0	0
OCT	100	0	0	0	0	0	0	0	0	0	0	0
TOT	26	14	19	14	11	8	4	3	1	<1	<1	<1
Upper												
APR	68	3	6	5	6	8	3	0	0	0	0	0
MAY	32	8	18	15	5	7	7	3	4	0	0	1
JUN	28	19	22	14	8	3	4	1	2	1	0	0
JUL	33	13	19	13	8	5	2	4	1	1	0	1
AUG	63	14	8	8	6	0	0	0	0	0	0	0
SEP	68	13	13	3	1	1	0	0	0	0	0	0
OCT	71	10	12	5	2	0	0	0	0	0	0	0
TOT	44	13	16	11	6	4	3	2	1	<1	0	<1

Length frequency histograms of walleye harvested by anglers for all of Lake Oahe (Figure 6) and from each reservoir zone (Figures 6-9) illustrate the non-selective nature of the angler harvest during 2003. The mean length of walleye harvested during the April-October 2003 period was highest in lower Lake Oahe at 401 mm (Figure 7) and decreased in an upstream direction, with mean walleyes lengths harvested of 393 and 380 mm for middle and lower Lake Oahe respectively (Figures 8 and 9). From examination of the length frequency distributions of walleyes harvested by anglers, it appears 300 mm (12 inches) is the length at which anglers begin to harvest walleyes caught. The length frequency histogram for smallmouth bass harvested during the April-October 2003 daylight survey period shows a lack of selection of smallmouth bass sizes by anglers (Figure 10). Smallmouth bass are typically an incidental catch by generalist or walleye anglers and length distribution of fish harvested is likely similar to the length distribution of fish caught. The exception is that 250 mm appears to be the length at which anglers begin harvesting smallmouth bass.

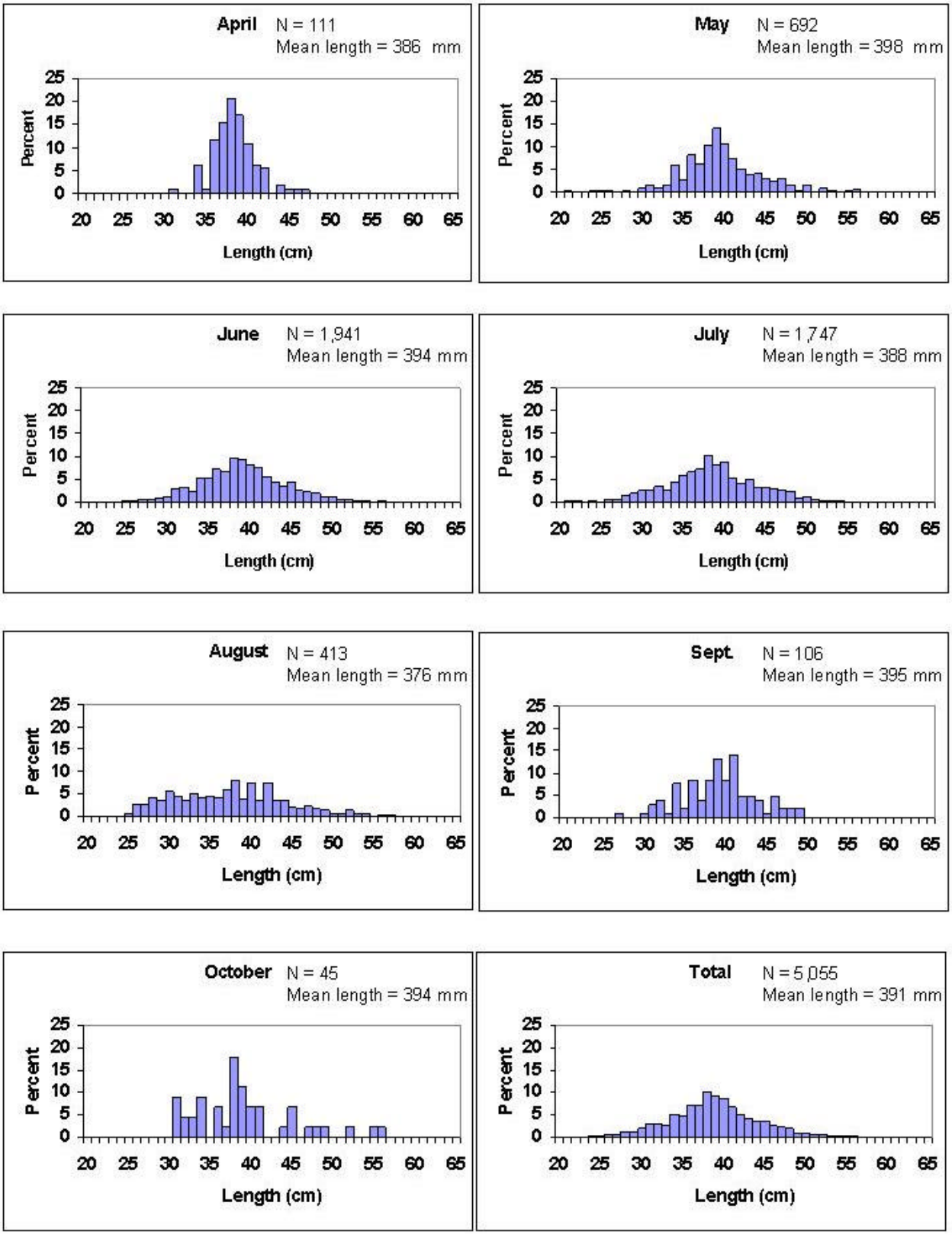


Figure 6. Length frequencies of walleye harvested during daylight hours, by month, for Lake Oahe, South Dakota, April-October 2003.

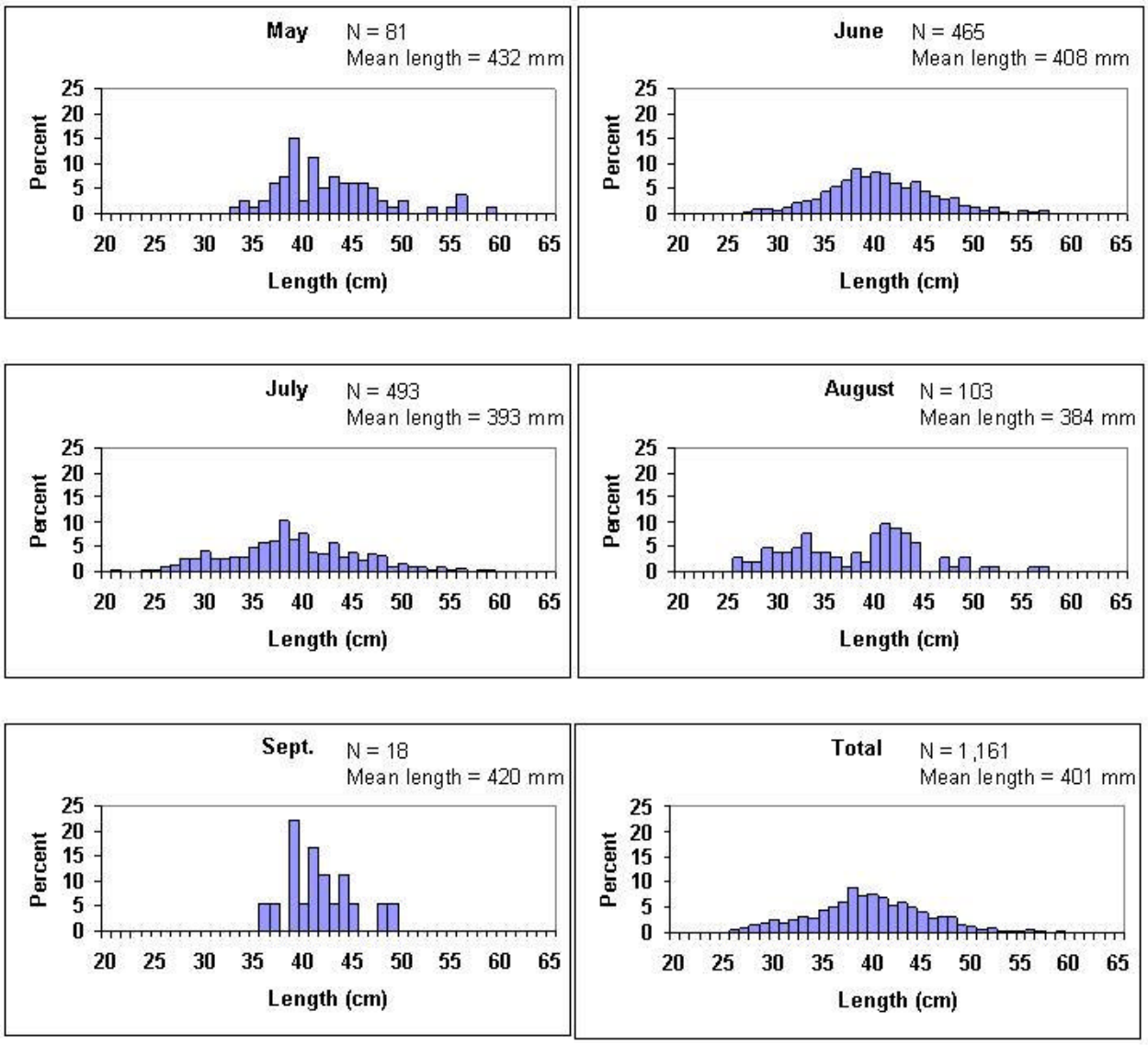


Figure 7. Length frequencies of walleye harvested during daylight hours, by month, for the lower zone of Lake Oahe, South Dakota, May-September 2003.

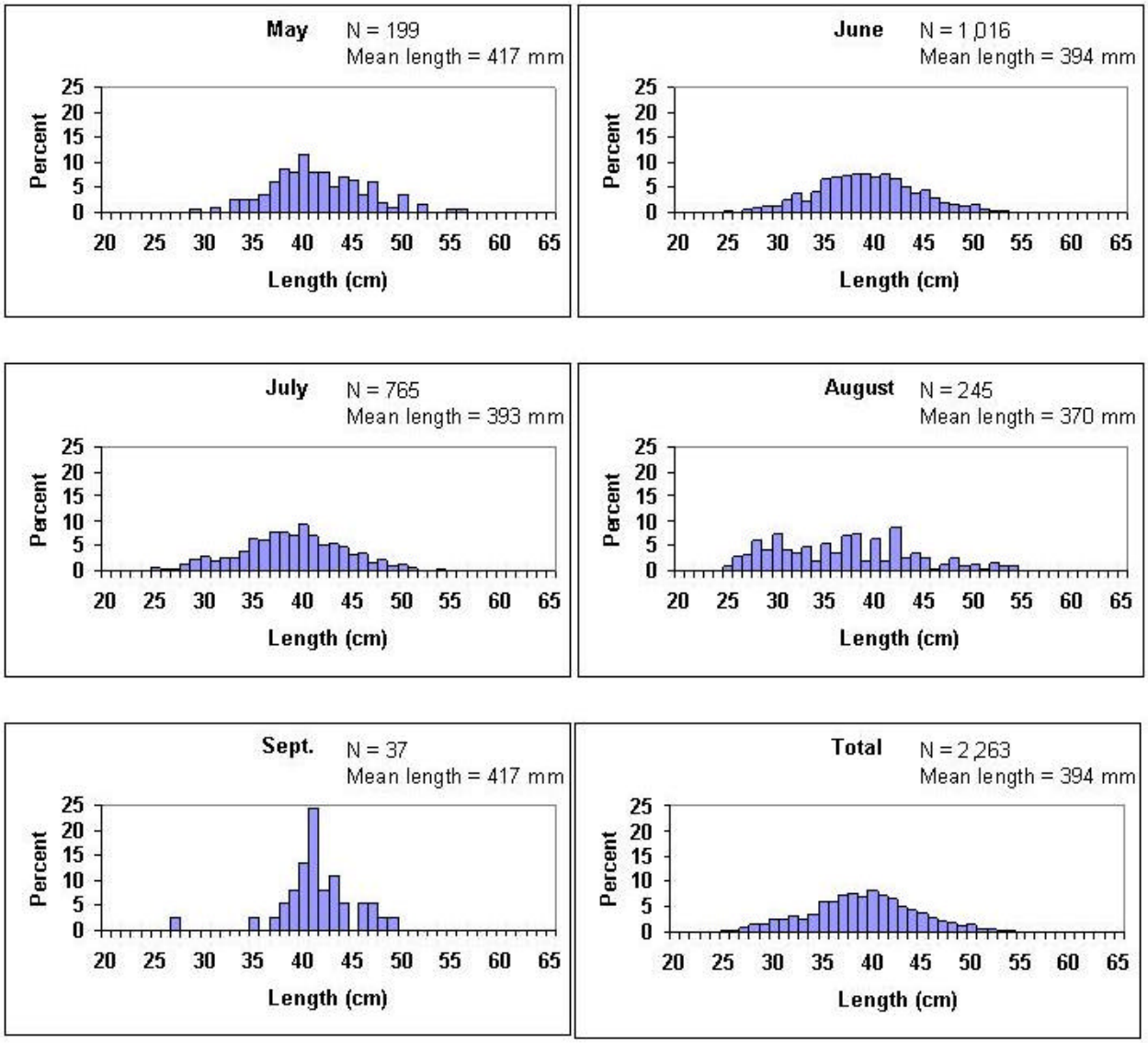


Figure 8. Length frequencies of walleye harvested during daylight hours, by month, for the middle zone of Lake Oahe, South Dakota, May-September 2003.

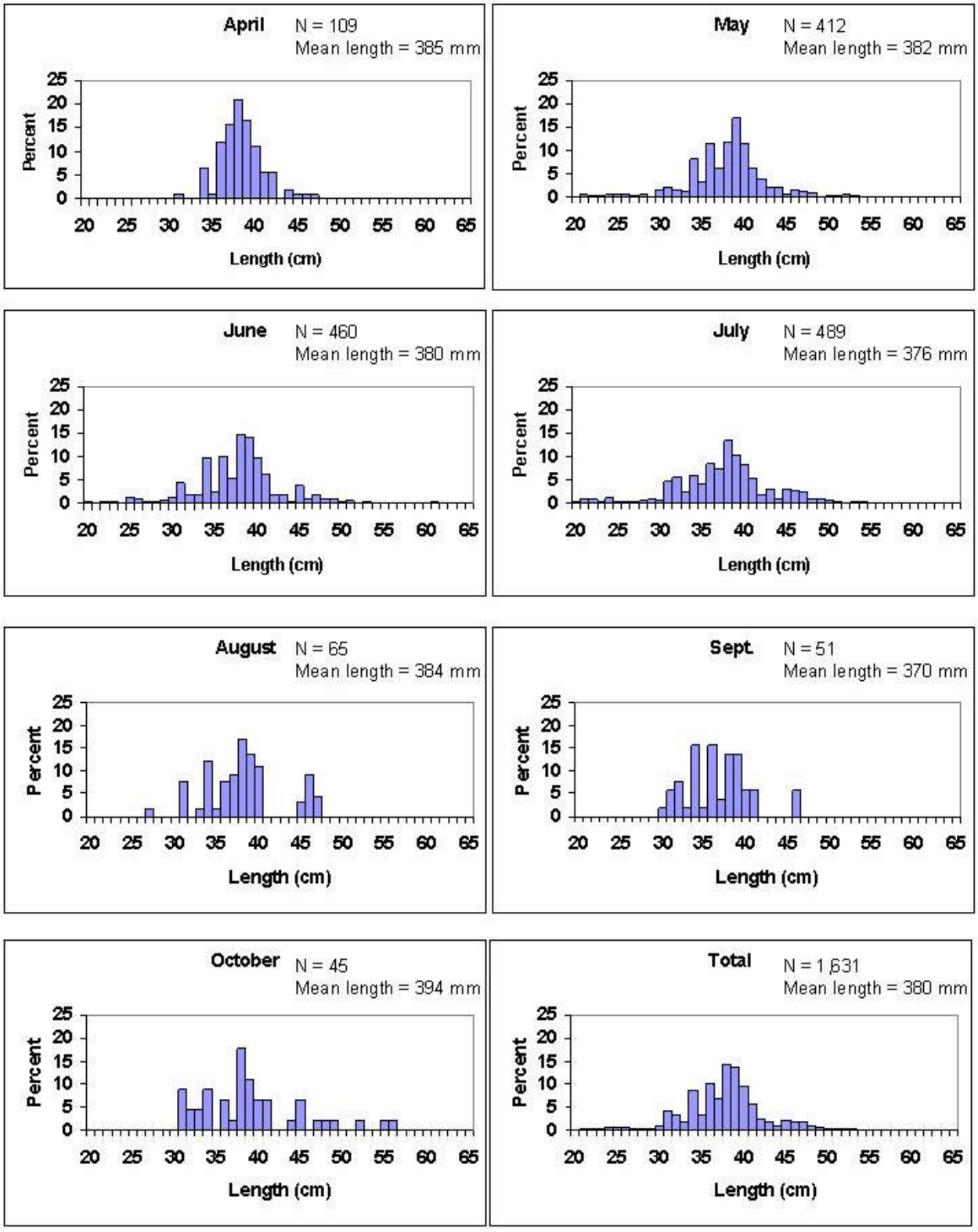


Figure 9. Length frequencies of walleye harvested during daylight hours, by month, for the upper zone of Lake Oahe, South Dakota, April-October 2003.

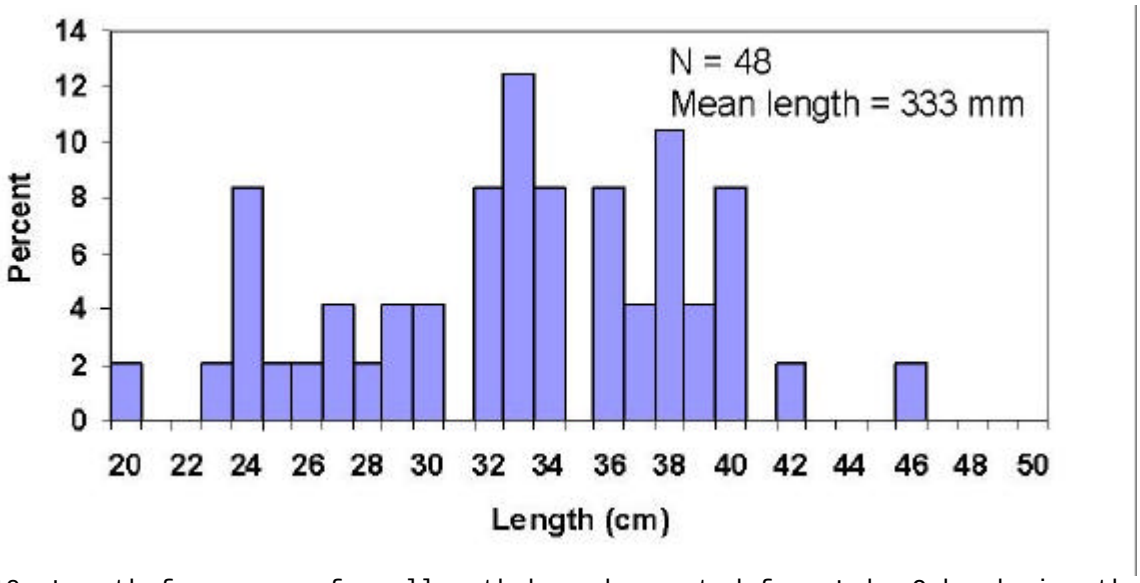


Figure 10. Length frequency of smallmouth bass harvested from Lake Oahe during the daylight hours of April-October 2003.

ANGLER DEMOGRAPHICS AND ECONOMICS

Mean angler trip length and party size for the April-October 2003 daylight period were 5.38 h and 2.3 people, respectively. Seventy five percent of anglers fishing Lake Oahe during the April-October daylight period that were interviewed, stated they were specifically fishing for walleye, while 15% stated they were fishing for anything (Table 32). Other species specifically targeted by anglers included Chinook salmon and northern pike, though only 5% and 4% of anglers targeted these species during 2003, respectively.

The distribution of the distance anglers traveled, one way, to fish Lake Oahe during the 2003 survey period was similar to 2002, with one exception. A lower percentage of trips were by anglers traveling 51-100 miles and a higher percentage of trips were by anglers traveling 101-200 miles, one way to fish Lake Oahe (Table 33).

Approximately 26% of angler trips on Lake Oahe during the April-October 2003 daylight period were made by nonresidents, a value similar to previous years. The percentage of total nonresident angler trips made by Minnesota and North Dakota residents decreased from 2002 to 2003, while the percentage of total nonresident trips by Nebraska residents increased (Table 34).

Table 32. Target species of Lake Oahe anglers during the April-October 2003 daylight period. Species abbreviations used appear in Appendix 1. Trace (T) indicates values less than 0.5%.

	Species						
	WAE	FCS	NOP	WHB	CCF	SMB	ANY
Percent of Trips	75	5	4	0	1	T	15
Number of Trips	91,218	6,007	4,384	0	896	303	18,300

Table 33. Percent of anglers traveling specified distances, one way, to fish Lake Oahe, South Dakota, 1995-2003.

Distance (miles)	Year								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
<25	21	21	21	25	27	27	29	24	25
25-50	3	5	4	4	5	6	2	7	8
51-100	13	15	13	8	9	5	10	12	4
101-200	22	18	18	21	21	21	18	14	19
200+	40	41	44	42	37	41	41	43	44

Table 34. Percent of non-resident anglers from various states that fished Lake Oahe, South Dakota, 1999-2003.

State	Year				
	1999	2000	2001	2002	2003
Minnesota	23	22	32	30	25
Nebraska	22	22	13	14	24
Iowa	20	20	16	18	17
North Dakota	6	8	15	14	8
Colorado	5	5	4	5	5
Wyoming	3	1	1	2	2
Wisconsin	4	3	7	5	6
Other	17	19	12	12	13

County of residence data for South Dakota anglers fishing Lake Oahe during 2003, for each reservoir zone and overall, is presented in Figures 11-14. Approximately 45% of resident angler trips on lower Lake Oahe during the April-October 2003 daylight period were made by residents of Hughes and Stanley Counties, while 15% and 13% of resident trips were made by anglers residing in Pennington and Minnehaha Counties, respectively (Figure 11). Anglers from Potter, Hughes, Spink, Beadle, and Sully Counties comprised the largest percentages of resident anglers fishing middle Lake Oahe (Figure 12). Residents of three counties comprised 80% of resident angler trips on upper Lake Oahe. Anglers from Campbell, Walworth and Brown Counties comprised 20%, 39%, and 21% of the total number of resident angler trips on upper Lake Oahe during 2003 (Figure 13).

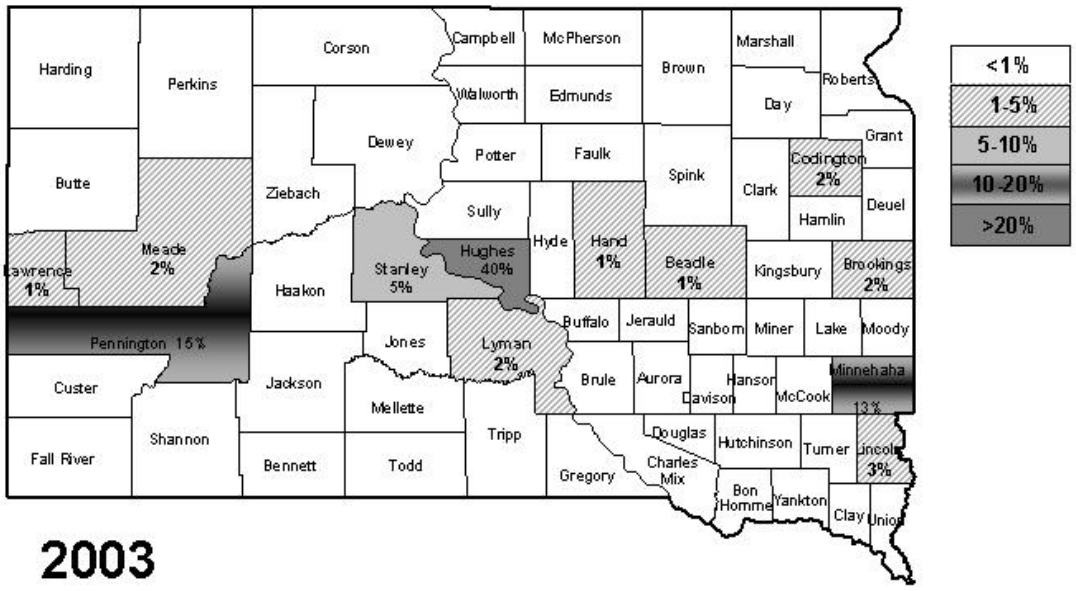


Figure 11. County of residency for South Dakota residents fishing lower Lake Oahe during the April-October 2003 daylight period.

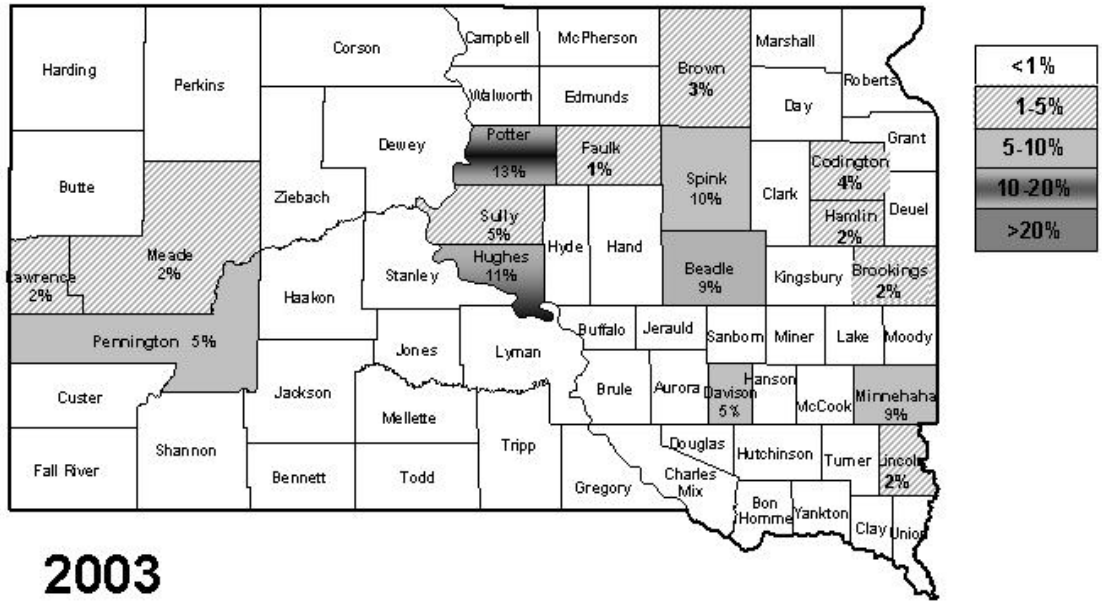


Figure 12. County of residency for South Dakota residents fishing middle Lake Oahe during the April-October 2003 daylight period.

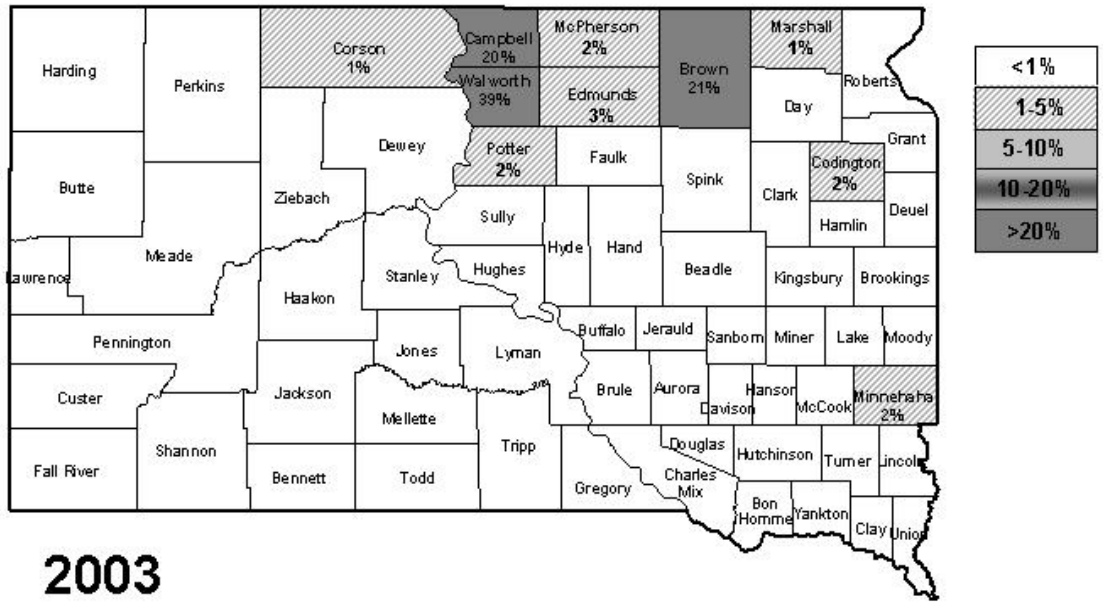


Figure 13. County of residency for South Dakota residents fishing upper Lake Oahe during the April-October 2003 daylight period.

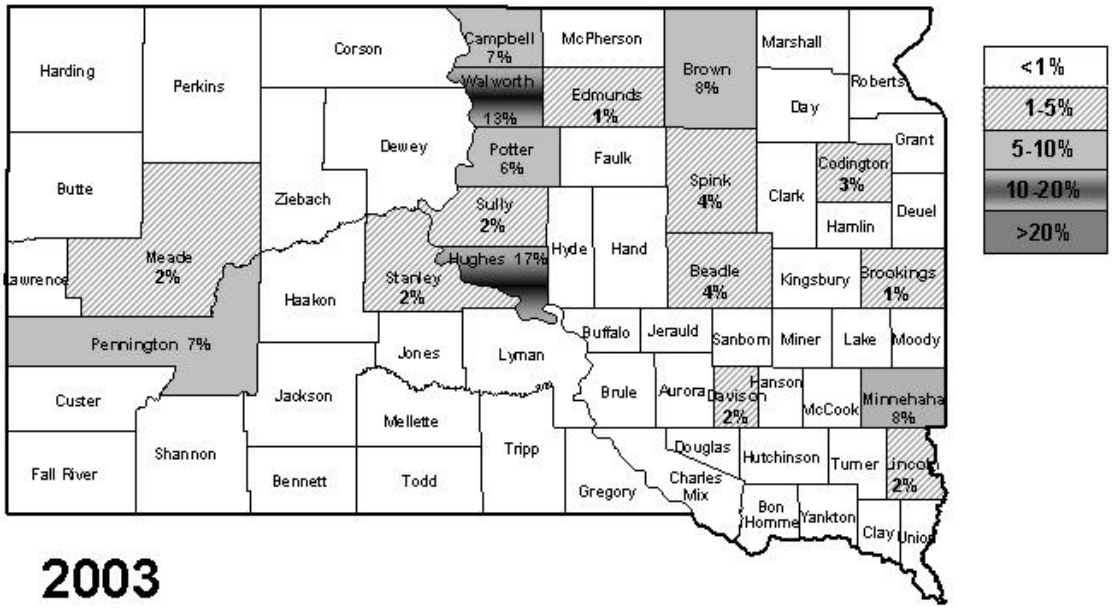


Figure 14. County of residency for South Dakota residents fishing Lake Oahe during the April-October 2003 daylight period.

Anglers answering interview questions were asked their age as part of the 2003 angler use, harvest, and preference survey on Lake Oahe. Twenty-two percent of anglers participating in angler interviews during the April-September 2003 daytime period were less than 40 years old (Table 35). Thirty-two percent of anglers answering interview questions were 60 years of age or older and 72% of anglers interviewed was between 40 and 70 years of age.

Table 35. Age frequency of anglers answering attitude, preference, and satisfaction questions during angler interviews on Lake Oahe during the April-October 2003 daylight survey period. T (trace) indicates values greater than 0.0 but less than 0.05.

Age group (years)	Number	Percent of total
0-4	0	0
5-9	1	T
10-14	6	T
15-19	15	1
20-24	35	2
25-29	82	4
30-34	111	6
35-39	155	8
40-44	205	11
45-49	234	13
50-54	215	12
55-59	181	10
60-64	300	16
65-69	189	10
70-74	74	4
75-79	39	2
80 and older	9	0

For the April-October 2003 daylight period, Lake Oahe anglers contributed approximately 7.4 million dollars to local economies, based on an estimated 121,107 trips (Table 19) at an estimated $61 per trip for South Dakota's Missouri River reservoirs (U.S. Dept. of Interior, Fish and Wildlife Service, and U.S. Dept. of Commerce, Bureau of the Census 2003).

ANGLER PREFERENCE AND ATTITUDE SURVEY

Anglers' attitudes about fishing, their preferences concerning management issues and their level of satisfaction are important components of a total fishery survey. Historically, fisheries managers have primarily focused on understanding biological aspects of fish populations and monitoring sport fish harvest and use. Recently, biologists have realized the necessity and value of understanding angler attitudes, levels of satisfaction, and preferences. Consequently, more attitude, preference and satisfaction data have been collected during recent years. The following results build on angler preference and attitude survey data collected previously for the Lake Oahe fishery (Stone et al. 1994; Johnson et al. 1997, 1998, 1999, Lott et al. 2000, 2001, 2002, 2003a).

ANGLER SATIFACTION AND TRIP RATING

How anglers feel about their fishing experience is important to the success of a fishery. Angler responses help evaluate if current management practices and regulations are providing a fishery that meets angler needs and expectations.

In terms of rating a trip based on catching the numbers of fish they were expecting, median angler trip ratings were generally “poor” (median=4), with the median value being “fair” in July and “very poor” in September and October (Table 36). A median trip rating, based on numbers of fish anglers were expecting to catch, of “poor”, was surprising as the mean hourly catch rate of walleye for the April-October 2003 daylight period was 0.42 fish/h (Table 25). However, the daily limit of 10 walleyes and mean hourly catch rate of walleye of 0.77 fish/angler-h in 2001 and 0.58 fish/angler-h in 2002 (Lott et al. 2002), may have set angler expectations high for 2003. When trip rating, based on numbers of fish anglers were expecting to catch, was compared with the number of walleye harvested per angler, it was evident that as harvest per angler increased, trip rating based on number of fish anglers were expecting to catch increased (Table 37). Median trip ratings, based on numbers of fish anglers were expecting to catch, were “poor” (median value of 4) for parties averaging 0.1-1.9 walleye harvested/angler, while trip ratings for parties averaging =4 walleye harvested/angler were generally “good” (median value of 2).

Table 36. Response to the question: “How would you rate your fishing today in terms of catching the numbers of fish you were expecting?” 1 = excellent, 2 = good, 3 = fair, 4 = poor, and 5 = very poor. These response categories are used in Tables 37-40. N is sample size and does not include “No opinion” (N.O.) responses.

Month	Rating your trip in terms of the numbers of fish you were expecting							
	1	2	3	4	5	N.O.	N	Median
April	6	2	9	7	16	0	40	4
May	9	1	10	19	27	4	66	4
June	16	15	26	41	43	4	141	4
July	14	15	34	21	40	13	124	3
August	9	6	10	26	42	0	93	4
Sept.	6	0	5	6	22	3	39	5
Oct.	1	1	1	3	8	3	14	5
Total	61	40	95	123	198	27	517	4
Percent	12	8	18	24	38			

Median trip rating, based on sizes of fish anglers were expecting to catch, was “poor” (median value of 4) for the April-October 2003 survey period, and “very poor” (median value of 5) during September and October (Table 38). When the average number of walleye harvested per angler was factored in, the median trip rating for angler parties increased from “very poor” for parties averaging zero walleyes/angler to “excellent” (median value of 1), for angling parties averaging seven or more walleyes/angler (Table 39).

Table 37. Response to the question: "How would you rate your fishing today in terms of catching the numbers of fish you were expecting?" compared to the average number of walleye harvested per angler. N is sample size and does not include "No opinion" (N.O.) responses.

Walleye /angler	Rating your trip in terms of the numbers of fish you were expecting							
	1	2	3	4	5	N.O.	N	Median
0	18	8	28	34	115	20	203	5
0–0.9	4	3	8	21	35	4	71	4
1–1.9	6	1	15	31	23	2	76	4
2-2.9	6	8	16	16	13	0	59	3
3-3.9	4	6	15	13	9	0	47	3
4-4.9	10	6	6	2	1	0	25	2
5-5.9	7	3	3	3	1	0	17	2
6-6.9	4	3	3	3	0	0	13	2
7-7.9	1	1	0	0	0	0	2	1.5
8-8.9	0	0	0	0	1	0	1	5
9-9.9	0	0	0	0	0	0	0	--
10	0	1	0	0	0	0	1	2

Table 38. Response to the question: "How would you rate your fishing today in terms of catching the sizes of fish you were expecting?" N is sample size and does not include "No opinion" (N.O.) responses.

Month	Rating your trip in terms of the sizes of fish you were expecting							
	1	2	3	4	5	N.O.	N	Median
April	2	3	9	7	12	1	33	4
May	7	9	10	17	17	5	60	4
June	22	24	18	33	43	5	140	4
July	19	22	25	25	44	10	135	4
August	3	10	15	18	39	7	85	4
Sept.	3	1	6	6	17	0	33	5
Oct.	2	0	1	2	11	1	16	5
Total	58	69	84	108	183	29	502	4
Percent	12	14	17	22	36			

Table 39. Response to the question: "How would you rate your fishing today in terms of catching the sizes of fish you were expecting?" compared to the average number of walleye harvested per angler. N is sample size and does not include "No opinion" (N.O.) responses.

Walleye /angler	Rating your trip in terms of the sizes of fish you were expecting							
	1	2	3	4	5	N.O.	N	Median
0	10	14	29	28	99	21	180	5
0–0.9	1	10	8	14	32	4	65	4
1–1.9	7	10	15	30	29	1	91	4
2-2.9	7	11	14	20	15	1	67	4
3-3.9	10	11	9	7	2	0	39	2
4-4.9	8	6	3	3	4	2	24	2
5-5.9	3	3	1	2	0	0	9	2
6-6.9	3	1	3	2	1	0	10	3
7-7.9	5	0	1	0	0	0	6	1
8-8.9	2	0	0	0	0	0	2	1
9-9.9	1	0	0	1	0	0	2	1
10	1	0	0	0	0	0	1	1

When asked to consider all factors when stating their level of satisfaction with their angling trip, 39% of respondents were satisfied with their angling trip and 44% were dissatisfied (Table 40). When considering all factors with regards to trip satisfaction, the median trip satisfaction rating for the April-October survey period was "neutral" (median value of 4). The percentage of anglers satisfied with their angling trip in 2003, at 39% (Table 40), decreased from 68% in 2001 (Lott et al. 2002) and 52% in 2002 (Lott et. al 2003a) and was below the LOSP objective of 70%.

Table 40. Response to the question: "Considering all factors, how satisfied are you with your fishing trip today?" 1 = very satisfied, 2 = moderately satisfied, 3 = slightly satisfied, 4 = neutral (neither satisfied or dissatisfied, 5 = slightly dissatisfied, 6 = moderately dissatisfied, 7 = very dissatisfied, and N.O. is no opinion. N is sample size and does not include "No opinion" (N.O.) responses.

Month	Satisfaction rating									
	Satisfied			Neutral	Dissatisfied			N.O	N	Median
	1	2	3	4	5	6	7	8		
April	1	5	7	4	1	5	1	1	24	3
May	4	7	6	9	6	17	4	1	53	4
June	25	19	14	24	19	23	10	2	134	4
July	20	24	15	25	13	17	17	2	131	4
August	6	10	8	11	12	13	15	0	75	5
Sept.	0	1	6	5	3	12	4	1	31	6
Oct.	0	0	1	1	2	5	3	0	12	6
Total	56	66	57	79	56	92	54	7	460	4
	39%			17%	44%					

The average number of fish harvested/angler seemed to influence total trip satisfaction (Table 41). Trip satisfaction generally increased as the average number of walleye harvested per angler increased (Table 41). The number of fish in a daily limit may influence angler expectations and thereby satisfaction. During the April-October 2000 daylight survey period, when a four walleye daily limit was in effect, anglers harvesting =1 walleye per angler trip had a median trip satisfaction of "moderately satisfied"(Lott et al. 2001). For the April-October 2003 daylight survey period when a 10-walleye daily limit was in effect, median trip satisfaction for anglers harvesting =1 walleye per angler trip was "slightly satisfied".

There is evidence that the degree of angler trip satisfaction attained is related to the percentage of the daily limit that an angler is able to harvest (Hudgins and Davies 1984). If the daily limit is only rarely attained by anglers, expectations are not being met and angler satisfaction is low (Cook et al. 2001). Information on angler catch and harvest rates and the angler harvest frequency distribution for the 2002 and 2003 Lake Oahe fisheries, help explain the decrease in trip ratings based on angler expectations and the decrease in overall trip satisfaction during this period. Hudgins and Davies (1984) documented that angler satisfaction decreased as the percentage of the daily limit anglers were able to attain decreased. Increasing the daily limit from four walleyes in 2000 to 14 walleyes in 2001 and 10 walleyes in 2002 and 2003 resulted in anglers attaining a lower percentage of the daily limit on an angler trip, and reduced satisfaction.

Table 41. Response to the question: "Considering all factors, how satisfied are you with your fishing trip today?" compared to the average number of walleye harvested per angler. N is sample size. Response categories are the same as those used in Table 40.

Walleye/ angler	Satisfaction rating								
	Satisfied			Neutral	Dissatisfied			N	Median
	1	2	3	4	5	6	7		
0	6	17	22	29	18	51	33	176	5
0–0.9	2	2	9	7	7	13	7	47	5
1–1.9	8	12	6	16	15	16	10	83	4
2-2.9	10	14	9	13	7	8	2	63	3
3-3.9	9	9	7	5	4	2	1	37	3
4-4.9	9	5	2	7	1	2	1	27	2
5-5.9	5	3	0	0	1	0	0	9	2
6-6.9	4	3	0	1	0	0	0	8	1.5
7-7.9	0	0	2	0	0	0	0	2	3
8-8.9	0	0	0	0	0	0	0	0	--
9-9.9	0	0	0	0	0	0	0	0	--
10	3	1	0	1	0	0	0	5	1
Total	56	66	57	79	53	92	54	457	4
	39%			17%	44%				

ANGLER PREFERENCES

Information on what anglers regard as a reasonable annual harvest of walleyes helps biologists understand angler characteristics, beliefs, and perceptions. Therefore, anglers interviewed in 2003 were asked what a reasonable total number of walleyes for one person to keep and eat or give away in a year would be. Approximately 51% of anglers interviewed stated a number between 20 and 59 walleyes, as a reasonable annual harvest, 19% of anglers stated a number between 60 and 99, and 24% stated a number ≥100 (Table 42). When asked how many walleyes they keep and eat or give away in a single year, 52% of respondents again stated they kept between 20 and 59 walleyes in a single year, 19% stated they kept between 50 and 99 walleyes, and 20% stated they kept 100 or more walleyes a year (Table 43). Anglers participating in interviews were asked either the question about a reasonable number of walleyes to harvest in a year or how many walleyes they harvested in a year but not both questions as they appeared on different interview forms. The fact that the frequency distributions for these two question responses are so similar may mean anglers think the number of walleyes they harvest in a year is reasonable.

Table 42. Percent of total responses to the question: “In your opinion, what would be a reasonable total number of walleyes for one person to keep and eat or give away in a year?” by month. N is sample size.

Number	Month							
	April	May	June	July	August	Sept.	Oct.	Total
0-9	0	3	1	2	5	0	6	**2**
10-19	0	3	6	3	8	0	0	**4**
20-29	16	7	8	14	16	6	0	**11**
30-39	13	15	10	15	10	8	0	**12**
40-49	13	15	15	11	5	14	12	**12**
50-59	9	19	17	20	11	11	12	**16**
60-69	19	7	8	2	7	14	24	**8**
70—79	0	4	8	11	9	14	24	**9**
80-89	9	1	1	1	5	3	0	**2**
90-99	0	1	0	0	0	3	0	**0**
100-149	16	18	16	10	21	28	12	**16**
150-199	6	0	3	4	1	0	6	**3**
200-249	0	3	2	3	0	0	6	**2**
250-299	0	0	1	0	0	0	0	**0**
300+	0	3	4	4	2	0	0	**3**
N	**32**	**68**	**143**	**125**	**87**	**36**	**17**	**508**

Table 43. Percent of total responses to the question: “About how many walleyes do you keep and eat or give away in a single year?” by month. N is sample size.

Number	Month							
	April	May	June	July	August	Sept.	Oct.	Total
0-9	0	6	1	2	6	0	0	**2**
10-19	0	2	7	6	12	0	8	**6**
20-29	10	13	12	11	16	0	17	**12**
30-39	20	15	11	14	16	13	0	**13**
40-49	15	19	13	9	10	6	8	**12**
50-59	25	8	15	17	12	16	17	**15**
60-69	5	10	9	8	10	13	8	**9**
70—79	10	2	8	9	4	22	25	**8**
80-89	0	0	1	4	0	0	8	**2**
90-99	0	0	0	1	0	3	0	**0**
100-149	10	13	15	12	7	19	8	**13**
150-199	5	2	5	2	4	0	0	**3**
200-249	0	8	0	2	1	6	0	**2**
250-299	0	0	1	1	0	0	0	**0**
300+	0	2	3	2	0	3	0	**2**
N	20	52	132	125	68	32	12	**441**

Anglers were also asked how many days they fished in South Dakota in a year and how many of those days were on Lake Oahe during the 2003 survey (Table 44). Approximately 19% of respondents stated they fished 9 days or less in South Dakota

in an average year, 42% of respondents fished 50 or more days, and 20% fished 100 or more days in an average year. When asked how many of these days were spent fishing Lake Oahe, 34% responded they spent 9 days or less on Lake Oahe, 27% fished Lake Oahe 50 or more days, and 12% fished Lake Oahe 100 or more days, in an average year (Table 44).

Table 44. Percent of total responses to the question: "On average, about how many days do you fish in South Dakota in a year?" and to the question "How many of those days are on Lake Oahe?" by month. N is sample size.

Number	Days in South Dakota in a year								Days on Lake Oahe in a year							
	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOT	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOT
0-9	14	17	26	15	23	9	0	19	18	26	37	34	45	23	23	34
10-19	4	10	14	14	11	23	31	13	4	18	18	19	12	23	23	17
20-29	0	12	10	11	11	5	8	10	11	19	11	8	6	5	0	10
30-39	4	9	10	14	9	9	0	10	4	9	8	10	7	0	15	8
40-49	14	7	5	7	6	5	0	6	14	9	4	5	6	9	8	6
50-59	4	14	4	7	10	0	0	7	7	5	5	5	2	14	0	5
60-69	11	7	4	6	6	14	8	6	11	5	3	5	4	9	0	5
70—79	4	0	4	6	2	0	0	4	4	0	2	2	2	0	8	2
80-89	0	2	3	3	0	5	0	2	0	2	2	0	2	0	0	1
90-99	0	0	4	4	1	0	8	3	0	0	5	1	1	0	0	2
100-149	14	16	7	8	15	14	23	11	7	2	3	5	7	5	0	5
150-199	4	0	6	5	4	14	8	5	0	0	3	4	1	9	8	3
200-249	7	2	1	1	1	5	8	2	7	2	0	1	1	5	8	2
250-299	11	3	0	1	0	0	8	1	11	4	0	0	0	0	8	1
300+	11	2	1	1	1	0	0	1	4	0	0	1	1	0	0	1
N	**28**	**58**	**136**	**132**	**82**	**22**	**13**	**471**	**28**	**57**	**131**	**129**	**82**	**22**	**13**	**463**

From 2001-2003, Nonresident Lake-Oahe-only annual and family licenses, and resident Lake-Oahe-only licenses were available for $20.00 (nonresident) or $7.00. During the 2003 April-October survey period, approximately 24% of anglers participating in angler interviews had a Lake-Oahe-only license in their possession (Table 45). Of the 24% of anglers possessing a Lake-Oahe-only license, approximately 38% were resident and 62% were nonresidents.

Table 45. Percent of total responses to the question: "What type of fishing license do you have?" N is sample size and percent is percentage of total sample.

Type of fishing license	N	Percent
Resident annual fishing	173	34
Resident combination	126	24
Resident senior fishing	26	5
Resident Lake Oahe only	44	9
Nonresident annual fishing	41	8
Nonresident one day fishing	11	2
Nonresident three day fishing	13	3
Nonresident family fishing	5	1
Nonresident Lake Oahe only	73	14
Nonresident family Lake Oahe only	3	1

WALLEYE FISHERY STATUS AND 2004 OUTLOOK

Walleye abundance, as indexed with gill net CPUE, decreased from 2002 to 2003 and was significantly lower than during the 1991-2000 period (Table 3, Figure 2). In addition to decreasing in abundance, walleye population biomass is also lower than during the 1993-2000 period because of lower population size structure at the current time than during most years in that period (Figure 2). There are indications that walleye condition and growth rates are increasing in relation to an increase in prey availability (Tables 4 and 17). As an example, mean length of walleye in the 1994 year class increased from 450 mm in 2002 (age 8)to 496 mm in 2003 (age 9); an increase of 46 mm or 1.8 inches for a fish beginning the year at 17.7 inches in length.

While a number of positive changes in walleye population status were documented during 2003, angler use and harvest of Lake Oahe was low. Estimated fishing pressure for the April-October 2003 daylight period, at 651,557 h, was the second lowest of years for which an April-October survey was conducted and was 76% of the 2002 estimate of 856,059 h (Table 18). Estimated walleye harvest for the 2003 survey period, at 181,528 fish, was the lowest of years for which April-October surveys were conducted (Table 18). The mean walleye catch rate for the April-October daylight period decreased from 0.59 fish/h in 2002 to 0.42 fish/angler-h in 2003.

Approximately 39% of anglers interviewed stated some degree of satisfaction with their fishing trip during the April-October 2003 period (Table 40), a value well below the 70% objective for Missouri River reservoir fisheries. Average walleye harvest per trip was 3.1 fish/trip, in 2001, and steadily decreased to 1.5 fish/trip in 2003 (Table 30). The daily limit for walleyes was 14 in 2001 and 10 in 2002 and 2003. Less than 1% of angler parties interviewed in 2003 harvested a daily limit of 10 walleye per angler, 4% harvested six or more walleyes per angler, and 12% harvested 4 or more walleyes per angler. Harvest per angler was generally a low percentage of the daily limit and may have contributed to the low percentage of satisfied anglers in 2003.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Walleye from the 1994-1996 period of high production, are still present in the walleye population, comprising 16% of the 2003 gill net catch. Walleye from the 2001 and 1999 year classes should dominate angler catches in 2004, however, as they comprised 55% of the 2003 gill net catch and have recruited to the fishery. As hourly catch rates have declined from the high documented during the 1998-2000 period, the ability of anglers to harvest a high number of walleyes on the average day of fishing has also declined. Reducing the daily limit for walleye to six fish for 2004 should not affect harvest potential but should increase angler satisfaction and the percentage of anglers harvesting a daily limit of walleyes.

The addition of age-0 gizzard shad to the prey base of Lake Oahe may contribute to walleye growth in the upper portion of Lake Oahe during periods of summer thermal stratification. Distribution of walleye in the water column, throughout Lake Oahe, may also be altered by the availability of age-0 shad as prey from the time they enter the food chain in mid-summer until they succumb to cold water temperatures the following winter. The fast growth exhibited by Lake Oahe walleye prior to 1997 was a result of walleye utilizing rainbow smelt as their primary prey source (Jackson et al. 1993; Bryan 1995). Fast growth of Lake Oahe walleye is dependent on a sufficient biomass of coldwater prey fish. Walleye that rely on age-0 gizzard shad, a seasonally available, warm-water prey fish, generally experience slower growth than fish relying on coldwater prey sources (Lott et al. 2003b; Stone and Sorensen 2003).

WALLEYE/SAUGER REGULATIONS for 2004

The 2004 walleye regulation package for the South Dakota portion of Lake Oahe will consist of a daily limit of 6 walleyes, of which at most four walleye may be ≥ 381-mm (15 inches) in length and at most one walleye may be ≥ 508 mm (20 inches) in length. The possession limit will be three times the daily limit, or 18 walleyes. All components of the regulation package will be in effect during all months of the year. Inexpensive Lake-Oahe-Only licenses will not be available because they are no longer needed to increase angling pressure as a mechanism to increase harvest and reduce walleye abundance to reduce predatory pressure on rainbow smelt. At hourly catch rates experienced in 2003 and expected in 2004, a daily limit of six walleyes will be more attainable for anglers and should result in an increase in angler satisfaction.

RECOMMENDATIONS

1. Continue and improve fish population and angler use and harvest surveys on an annual basis. Specifically, add a 15.2-m panel of 64-mm (2 ½-inch) mesh to standard coolwater gill net sets and add a >18-m depth zone, consisting of three net sets, to the Peoria Flats, Cow Creek, Bush's Landing and Whitlocks Bay sampling stations.

2. Continue to incorporate Lake Oahe Strategic Plan and species management plan objectives and strategies into the evaluation of fish population and angler use and harvest surveys.

3. Inventory habitat and identify habitat issues related to fish population management. Document impacts of developing tourism industry (resorts, marinas, etc.) and other developments on availability and quality of habitat.

4. Develop environmental monitoring and data acquisition procedures with cooperation from the South Dakota Dept. of Environment and Natural Resources, the Corps of Engineers and other federal agencies. Specifically monitor plankton densities, nutrient levels, water temperature, sedimentation patterns, reservoir inflows, outflows and exchange rates, and shoreline erosion rates, for use in analysis of fish population performance.

5. Continue to work on diversifying angler use of the fishery, especially for channel catfish, white bass, and smallmouth bass.

6. Closely monitor angler use and harvest on Lake Oahe during 2004 to determine appropriateness of the current walleye regulation package.

7. Continue to monitor angler attitudes towards regulations and their angling experience by including angler attitude and preference questions in angler interviews conducted as part of the annual angler use and harvest survey.

8. Work with other South Dakota government agencies and interstate and federal entities to improve water management in the Missouri River system to better reflect needs of fish and wildlife species in the upper Missouri River (Montana, North and South Dakota).

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APPENDICES

Appendix 1. Common and scientific names of fishes mentioned in this report.

Common Name	Abbreviations	Scientific Name
Bigmouth buffalo	BIB	*Ictiobus cyprinellus*
Black bullhead	BLB	*Ictalurus melas*
Black crappie	BLC	*Pomoxis nigromaculatus*
Brassy minnow	BRM	*Hybognathus hankinsoni*
Channel catfish	CCF	*Ictalurus punctatus*
Chinook salmon	FCS	*Oncorhynchus tshawytscha*
Common carp	COC	*Cyprinus carpio*
Emerald shiner	EMS	*Notropis atherinoides*
Fathead minnow	FHM	*Pimephales promelas*
Flathead chub	FLC	*Platygobio gracilis*
Freshwater drum	FRD	*Aplodinotus grunniens*
Gizzard shad	GZD	*Dorosoma cepedianum*
Goldeye	GOE	*Hiodon alosoides*
Johnny darter	JOD	*Etheostoma nigrum*
Lake herring	LAH	*Coregonus artedii*
Largemouth bass	LMB	*Micropterus salmoides*
Northern pike	NOP	*Esox Lucius*
Rainbow smelt	RBS	*Osmerus mordax*
Rainbow trout	RBT	*Oncorhynchus mykiss*
River carpsucker	RIC	*Carpiodes carpio*
Red shiner	RES	*Cyprinella lutrensis*
Sauger	SAR	*Sander canadensis*
Shorthead redhorse	SHR	*Moxostoma macrolepidotum*
Shortnose gar	SHG	*Lepisosteus platostomus*
Shovelnose sturgeon	SHS	*Scaphirynchus platorynchus*
Smallmouth bass	SMB	*Micropterus dolomieu*
Smallmouth buffalo	SAB	*Ictiobus bubalus*
Spottail shiner	SPS	*Notropis hudsonius*
Walleye	WAE	*Sander vitreus*
White bass	WHB	*Morone chrysops*
White crappie	WHC	*Pomoxis annularis*
White sucker	WHS	*Catostomus commersoni*
Yellow perch	YEP	*Perca flavescens*

Appendix 2. Standard weight equations used for relative weight calculations. Length is in millimeters, weight is in grams, and logarithms are to base 10.

Walleye	LogWs=3.180LogTL-5.453
Channel catfish	LogWs=3.249LogTL-5.800
Yellow perch	LogWs=3.114LogTL-5.138
White bass	LogWs=3.230LogTL-5.386

Appendix 3. White bass and yellow perch proportional stock density (PSD), relative stock density of preferred- and memorable-length (RSD-P and RSD-M) fish, and relative weight (*Wr*) for 1997-2003, from Lake Oahe, South Dakota. Mean *Wr* values for 2002 and 2003 are for stock-length fish only.

White bass

Year	PSD	RSD-P	RSD-M	Wr	Sample size
1997	100	59	3	93	186
1998	95	62	2	89	188
1999	100	82	2	89	170
2000	99	86	1	85	121
2001	100	91	3	92	149
2002	68	65	5	88	140
2003	100	38	1	93	127

Yellow perch

Year	PSD	RSD-P	RSD-M	Wr	Sample size
1997	33	0	0	91	296
1998	58	1	0	83	103
1999	57	6	0	89	63
2000	44	5	0	86	63
2001	55	6	0	90	65
2002	40	14	0	80	35
2003	26	3	0	84	63

Appendix 4. Angler preference and attitude questions asked in conjunction to the 2003 Lake Oahe angler use and harvest survey.

How would you rate your fishing today in terms of catching the sizes of fish you were expecting?

How would you rate your fishing today in terms of catching the numbers of fish you were expecting?

Considering all factors, how satisfied are you with your fishing trip today?

In your opinion, what would be a reasonable total number of walleye for one person to keep and eat or give away in a year?

About how many walleye do you keep and eat or give away in a single year?

On average, about how many days do you fish in South Dakota a year?

How many of those days are on Lake Oahe?

What type of fishing license do you have?
